Anglia Ruskin University

SUSTAINABLE INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) INITIATIVES IN UK AND IRISH UNIVERSITIES AND COLLEGES: IDENTIFYING AND OVERCOMING THE BARRIERS TO IMPLEMENTATION.

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A thesis in partial fulfilment of the requirements of Anglia Ruskin University for the award of a Professional Doctorate.

Submitted: July 2017

ANGLIA RUSKIN UNIVERSITY

ABSTRACT

FACULTY OF SCIENCE and TECHNOLOGY

PROFESSIONAL DOCTORATE

SUSTAINABLE INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) INITIATIVES IN UK AND IRISH UNIVERSITIES AND COLLEGES: IDENTIFYING AND OVERCOMING THE BARRIERS TO IMPLEMENTATION.

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July 2017

Energy is one of the UK's biggest commercial and environmental concerns. Despite government campaigns for everyone to play their part in minimising energy consumption, reports suggest an estimated 20–30% of energy generated is wasted.

UK and Irish universities and colleges are no exception to this wastage. In an attempt to reduce CO_2 emissions created by the extensive use of ICT equipment, JISC launched their Greening of ICT programme in 2009. The programme aimed at reducing ICT energy use in UK FHEs and its outcomes indicated that using fewer, more energy-efficient ICT resources, as infrequently as is practicable, is the optimal way of tackling energy waste. Two projects that did this were The Scotland Carbon and Energy Management Project and The UK SUSTE-TECH Project.

This research bridges the gap in knowledge, (identifying the barriers to FHE institutions implementing sustainable ICT initiatives) and, over the course of three consecutive stages, employed positivistic and anti-positivistic paradigms, utilised

inductive, abductive and deductive methodologies and employed comparative, correlative and evaluative research methods. Data were gathered using surveys and questionnaires.

Seven barriers to sustainability were identified, with three of them (stakeholder engagement, lacking managers and cuts in funding) being widespread. Each of the barriers existed to various extents and most underpinned one another. However, overcoming the barriers is possible via the use of a smartphone web app named the Energy Detective web app. These findings validate this research's theory and ultimately answers the research question and its sub-questions.

This research demonstrates that, according to various FHE managers, the same barriers to sustainability exist in UK and Irish FHEs regardless of geographical location. However, through sufficient engagement with stakeholders, they can be overcome. A solution to the gap in knowledge was found but not without difficulty. Recommendations for the continuation of this research have been made.

Keywords: Sustainable, Information Communication Technology (ICT), Participation, Further and Higher Education (FHE), Universities and Colleges, Stakeholders, Barriers.

Acknowledgments.

This project has been made possible through part-funding from the JISC Greening of ICT Programme, their project partner, the Environmental Association of Universities and Colleges (EAUC) and Goldsmiths, University of London.

I would like to extend my sincere gratitude to both my academic supervisors, Dr. Carlos Jiminez- Bescos and Dr. Ian Frame, for their guidance and advice throughout the project. Their ideas for directions on the project throughout this research proved invaluable.

I would also like to thank Dr. Malvern Tipping and Dr. Muhammad Uzman Mazhar for their advice and guidance on various aspects of this research.

I would especially like to thank Richard Groves of Goldsmiths, University of London for his help with the Energy Detectives project and with the monitoring of overall energy use across campus at Goldsmiths.

My fellow Professional Doctorate candidates, for their participation in lengthy discussions over requirements of the Professional Doctorate.

The hundreds of university staff and students who participated in the three stages of this research. Whether through participation in the Scottish or UK sustainable ICT projects, the completion of questionnaires, or by using the Energy Detective web app to report ICT energy waste at Goldsmiths, each made a worthwhile contribution.

And last, but by no means least, my family for their continuous encouragement and support during all of my academic pursuits.

This thesis is dedicated to the memory of my mother,

Marie Honour Hogan,

(Psychiatric Nurse)

1944–2015;

and

to the memory of my school friend Sarah Monahan,

(Sustainable Architect)

1974–2015;

and

to the memory of my cousin Siobhan Conlon,

(Shopkeeper and Baker)

1969–2016.

List of Abbreviations

AoC .....Association of Colleges

AUDE .....Association of University Directors of Estates

AASHE.....American Association for Sustainability in Higher Education

AACC…… American Association for Community Colleges

BOE……Board of Education

BUFDG ..... British Universities Finance Directors Group

CER . ..... Conference for European Rectors

CIPS…….. Chartered Institute of Procurement and Supply

COPERNICUS…….Co-operation Programme in Europe for Research on Nature and Industry through Coordinated University Studies

CRC .....Carbon Reduction Commitment

CSR ..... Social and Corporate Responsibility

DHEC……...Department of Health and Environmental Control

EAUC..... Environmental Association for Universities and Colleges

EMU.....Environmental Management Unit

EPA.....Environmental Protection Agency

EPAP ..... Environmental Policy and Action Plan

FHE.....Further and Higher Education

GDP. ..... Gross Domestic Product

GeSI..... Global e-Sustainability Initiative

GUPES……...Global Universities Partnership on Environment and Sustainability

HEA. .....Higher Education Academy

HEAnet……Higher Education Access Network (Ireland's National Education and Research Network)

HEEPI ..... .Higher Education Environmental Performance Improvement

HEFCE… ..... Higher Education Funding Council for England

HEI……..……Higher Education Institution

HESA……..……..….Higher Education Statistics Agency

ICT. .....Information Communication Technology

IUA……..……..…….Irish Universities Association

JISC ..... Joint Information Systems Committee

JMU .....John Moore's University

LiFE Index .....Learning in Future Environments

MFD ..... Multifunctional Device

NCVER…….……National Centre for Vocational Education Research

NUS ..... National Union of Students

R.O.I .....Return on Investment

RSC .....Regional Support Centres

SEAI.....Sustainable Energy Association of Ireland

SFC..... Scottish Funding Council

SME ..... Small to Medium Sized Enterprises

UCISA..... Universities and Colleges Information Systems Association

ULSF.....University Leader for a Sustainable Future

UN……..United Nations

UNCSD…….…….. United Nations Commission on Sustainable Development

UNESCO……United Nations Educational, Scientific and Cultural Organisation

UUK .....Universities UK.

WCESD…….World Commission on Environment and Sustainable Development

Web App ..... Worldwide Web Application

WLC Tool.....Whole Life Costing Tool

The words *universities and colleges* and the abbreviation *FHE* are used interchangeably.

The words *green* and *sustainabilit*y are also used interchangeably.

Where reference is made to the UK SUSTE-TECH project, the UK in this instance refers to all regions of the United Kingdom excluding Scotland.

In some instances the size of text was reduced to size 10 or smaller to accommodate it fitting neatly into a table or figure.

The headings of tables and titles of figures are written using single line spacing and bold font. This is to give them a better appearance and to distinguish them from the main body of text.

List of Figures.

List of Tables.

Chapter 1. A Synopsis of this Research.

1.0 Introduction.

There is an ongoing problem within the UK and Irish university and college sector relating to poor environmental performance, particularly where energy is concerned. Such poor performance typically results in wasted resources, disgruntled staff and dissatisfied students (Enochs, 2012; People and Planet, 2012; EAUC, 2016b). Improving environmental performance firstly involves identifying any barriers that may be causing poor performance and this research does exactly that, specifically focussing on barriers to implementing sustainable ICT initiatives. This chapter explains the significance of this research and how it evolved over three stages. It introduces the concept of sustainable ICT and its use in the FHE sector. This chapter also introduces the research question and sub-questions and explains how they stemmed from its overall aims and objectives. Finally, this chapter discusses the research paradigms, methodologies and methods used, the research's overall contribution to knowledge the impact it has had on the sector.

1.1 The Significance.

This research identifies seven barriers to UK and Irish universities and colleges participating in sustainable ICT projects. Since identification of those barriers, an ICT solution has been created in the form of a smartphone web app called the *Energy Detectives* web app. This web app allows for at least three of the barriers to be overcome and in doing so, ICT energy waste at Goldsmiths, University of London is being reduced along with their carbon emissions and ICT running costs. Crucial data in relation to energy wastage is automatically being reported to the estates and facilities managers via the web app, while at the same time staff and students are re-engaging with the concept of participating in the sustainable operations of their campus. This chapter also includes the background to this research. It explains how the research question and its sub-questions were conceived and how its aims and objectives have eventually been arrived at. It also explains the three stages of this research – how they were originally not part of the same project – but the failure of one stage resulted in the outcomes of the other, which subsequently evolved into this professional doctorate.

1.2 The Stage 1 of this Research.

Stage 1 of this research pertains to the outcomes of the Scotland ICT Carbon and Energy Management Project and the UK SUSTE-TECH project. The aim of both projects was to examine and reduce – via the use of greener technologies – the ICT related energy use of universities and colleges. However, recruitment to and full participation in both projects proved much slower and intermittent than originally anticipated. A combination of a lack of time and of resources to devote to either of the projects coupled with a lack of financial capital to invest in sustainable ICT equipment were the predominant reasons given for such poor participation. It was during this stage of the project that the original research question – *Identification of principal barriers to optimal sustainable performance in universities and colleges and how a series of ICT-related solutions can overcome those barriers* – was conceived.

1.3 The Stage 2 of this Research.

Stage 2 of this research pertains to the design of the conceptual framework and the creation and circulation of a large and detailed survey based on the conceptual framework. By this stage of the research, seven possible barriers had been tentatively identified and compared against the outcomes of the Scottish Carbon and Energy Management project and the UK SUSTE-TECH projects (Stage 1). This comparative analysis indicated that five of the seven barriers existed, with three barriers occurring predominantly. A larger, more detailed survey focussing on those seven barriers was circulated to the same group of FHE managers and to 215 other FHE managers too, to examine the scope of the barriers existence. The results of that survey indicated that all seven barriers had been experienced by a variety of FHE managers, to varying degrees with the existence of those barriers varying between institutions. A more detailed analysis of those results is included in Chapter 5.

1.4 The Stage 3 of this Research

An explanation of how the researcher devised and created an ICT solution to overcoming the barriers is given in Chapter 6. Called the Energy Detectives Chapter, this chapter includes figures illustrating where and when across Goldsmiths campus energy waste was prevented via stakeholder engagement with the Energy

Detectives' web app. Chapter 7 offers an overall conclusion to the outcomes of the research including recommendations for improvements. The subject of sustainability in universities and colleges is examined along with the use of ICT in campus operations. A section on organisations in the UK and abroad, whose aim is to facilitate improved environmental performance within the sector, is also included. How the original research question was arrived at and why it changed is also explained, as is the uniqueness and impact of this research and how it has improved practice.

1.5 The Context for the Research

Universities, because of their size, population, level of resource consumption and volume of waste produced, are often compared to small cities. Many universities nowadays engage in environmentally sustainable activities and have an environmental policy in place, but thousands more do not. Research shows that even in universities where concerted action in campus "greening" had taken place, there was ample room for improvement (Alshuwaikhat and Abubakar, 2008; People and Planet, 2016). It is widely acknowledged that universities and colleges are typically long–lived institutions where the investment of time and money into robust environmental frameworks will prove frugal and socially responsible (Hammond-Creighton, 2006; Reza, 2016; Zou et al., 2015). It is also widely acknowledged that implementing sustainable initiatives is rarely a simple or quick process (Hogan, 2009; James and Hopkinson, 2009; Velazquez et al., 2006; Sharpe, 2002). In reality implementing such changes is complicated and fraught with obstacles and barriers. However, for each obstacle and barrier to developing and implementing a sustainable strategy, there exists a solution, underpinned by sufficient funding, adequately resourced managers and engaged stakeholders. With a sufficient budget to recruit enough staff who can engage with stakeholders, environmentally sustainable projects – ICT or otherwise – stand a better chance of being successful (Estermann and Bennetot Pruvot, 2011; Papaspyropoulos, 2016).

1.6 Barriers to Sustainability

There are numerous barriers and hurdles to implementing environmentally sustainable projects (Pinkse and Dommisse, 2009; Puritt, 2012). There are equally as many reasons for the failure of sustainable projects that, once started, were never completed or never achieved their initial goals. Sometimes these reasons are outside of the control of otherwise willing participants and include lack of funding or time, but ultimately result in a waste of institutional funding and resources and of the time and efforts of those involved (EAUC, 2011a; Appendix I; Appendix I.1). However, most barriers can be overcome.

1.7 Sustainable ICT.

The institutional benefits of using sustainable ICT equipment are numerous (Worthington, 2010). The most obvious one is the financial savings that can be gained by utilising more energy efficient equipment (James and Hopkinson, 2009; Baroudi et al., 2009). Consuming less electricity also means releasing fewer CO_2 emissions so carbon targets are achieved (Carbon Trust, 2016a; GOV.UK, 2014a). Other institutional benefits include staff being able to work independently of their workplace and not having to travel for meetings (JISC, 2011). This saves on transport costs and travel time and can minimise the need for office space and its associated heating and lighting costs. Using video conferencing technologies for example allows more specialist staff to attend events they otherwise could not. Despite advancements in green ICT, in 2009 universities and colleges were still using older, inefficient equipment and paying “their exorbitant running costs” (James and Hopkinson, 2009). Some institutions insisted the expiration date of their procurement contracts prevented them from choosing a more sustainable piece of equipment (Appendix II and Appendix II.1), while others insisted a lack of financial resources restricted them purchasing anything new (Appendix I). Ironically, research has shown that savings made year on year in energy costs, through the use of more sustainable ICT equipment, can far exceed initial purchase costs. In fact, such cost can be recouped in as little as two years (Jeffrey, 2011; James and Hopkinson, 2009). ICT can even be used as an enabler for an improved sustainable performance as smart meters facilitate the reporting of real-time energy consumption and mobile devices allow for social activism of stakeholders (Bull et al, 2014; LoveCleanStreets, 2016). The SMART 2020 report revealed that ICT’s unique ability to monitor and maximise energy efficiency, both within and outside of its own

sector can lead to emission reductions five times the size of the sectors own footprint (GeSI, 2016).

Table 1.1 Sustainable ICT initiatives and the advantages of their use.

Sustainable ICT Option	Advantages of Use
Duplex Printing and Copying.	Implementing double-sided printing and copying by default on all printers and copiers saves on paper costs, energy costs and printing time. Using recycled paper and scrap paper and switching off printers and copiers when not in use, also saves on energy and paper costs.
Thin Client Technology.	Using smaller, more streamlined, more compact equipment that requires less energy to operate and is often less expensive to purchase. It also typically has a smaller footprint.
Cloud Computing.	Utilising cloud computing to deliver computer services over the internet by external service providers such as Google or Amazon saves money and space as fewer in-house servers and IT support staff are required.
Automatic Shutdown of PCs When Not In Use.	This initiative is often free and highly effective. Many institutions' IT managers have created their own automatic shutdown programme and reported instant energy savings.
Virtualisation.	Similarly to cloud computing, virtualisation allows data storage and other computer services to be stored off site thus eliminating running costs associated with on-site data centres such as operational staff and air-conditioning. (Hogan, 2010)

Table 1.1 above shows a list of sustainable ICT initiatives and the advantages of their use. It follows that barriers to implementing such greener technologies result in a loss of the benefits of their use, indicating the problems in practice and therefore a gap in knowledge.

1.8 Problems in Practice/ Gap in Knowledge.

As in all sectors, there exist gaps between what the FHE sector claims to practise and what, in reality, occurs on a daily basis. This gap, known as *value action gap,* occurs for a number of reasons (Chaplin and Wyton, 2014). Where this research is concerned, it existed when unsustainable behaviour continued in institutions that

had an environmental or sustainable policy in place, had agreed to endeavour to reach CO_2 targets and had the support of senior management and green champions.

As an example of this, it occurred when managers failed to participate fully in their respective Scottish or UK sustainable ICT project, despite being aware of the financial and environmental benefits it would bring.

From 2010 to 2012 it appeared as though the FHE sector was continuing in its failure to realise that investing in sustainable ICT initiatives reaps rewards through reduced purchase, running and disposal costs and through reducing CO_2 emissions. Instead, sustainable initiatives were, and still are, seen as being non-essential to the core business of running an FHE and more as an activity to appear to be doing for improved sector reputation (Mazhar, 2016).

1.8.1 The Case for this Research.

It was during the recruitment stage of the UK SUSTE-TECH project that it became increasingly apparent that barriers to participation existed. Institutions were reluctant to participate despite being offered funding for expert support that would see them reach their carbon targets while at the same time save money. An impromptu survey carried out revealed two reasons for the slow uptake – limited funding for the purchase of new greener ICT equipment and even fewer staff with enough time and resources to allocate to the project (Appendix I ; Appendix I.1). It was at this stage that cuts in funding were considered to be the principal – if not a significantly underpinning – barrier, but this theory required further research. In addition, the need to establish if other barriers existed was also required. It was at this stage that the main research question and its sub-questions were devised. The research question asked:

1. What are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives?

The sub-questions asked:

2. What are the key implications of those barriers?
3. How can a sustainable ICT solution alleviate those barriers?

1.9 The Researcher's Contribution to the Professional Doctorate.

1.9.1 The aims and objectives.

The overall aim of this research is to improve the use of ICT as an effective tool for a more sustainable future in universities and colleges. Its associated objectives are to:

1. Identify the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives.
2. Develop an ICT-based solution to overcome those barriers.

1.9.2 Uniqueness of this Research.

Since 2006, the researcher has researched three sustainable ICT projects based in universities and colleges in both the UK and Ireland. Participation in each of the projects was adversely affected with the result that financial and sustainable savings were lost and unsustainable practices continued. This research proposes that those effects are the result of a combination of sector–specific barriers, with cuts in funding to the sector underpinning all other barriers. To date, no other research has addressed this question in depth using data from the Scottish Carbon and Energy Management project and/or the UK SUSTE-TECH project to demonstrate the presence or absence of barriers. Another unique aspect to this research is that three of the barriers were overcome using the ICT-based solution, the Energy Detectives web app which has resulted in reduced levels of energy waste at Goldsmiths, University of London.

1.10 Research Paradigms, Methodologies and Methods

Much of the research in the Scottish and UK ICT projects was being done with the intent of creating energy improvements and then documenting those improvements therefore the type of research being conducted in The Stage 1 can be considered case study research. As the research progressed, a series of barriers was identified. Research into the barriers was therefore considered inductive and the

methodological approach was anti-positivistic, employing qualitative methods of research. As the research evolved further in the form of examination of the results of a detailed survey and examination of the outcomes of case studies, it became positivistic and abductive, employing mixed methods of research as data were being tested against a set of parameters. Finally, armed with new knowledge on barriers to implementation of ICT initiatives, “barrier-free” action research took place at Goldsmiths in partnership with engaged and coordinated stakeholders (Costello, 2003) that was positivistic and deductive, employing quantitative data.

1.11 Energy Detectives at Goldsmiths, University of London.

In September of 2015, the Energy Detectives web app was launched during Goldsmiths, University of London’s Freshers’ Fair. The sustainability officer (who is also the researcher), an outside IT contractor and member of the Goldsmiths Information Technology and Information Services (IT&IS) team worked on creating a web app that is easy to use and reports data relating to ICT energy wastage. Several members of the estates and facilities team reported in excess of 300 incidents of energy wastage. Those incidents were addressed and initiatives put in place to prevent reoccurrence. In the four months from January to April 2016 (inclusive) the initiative saved the university over £300 in energy costs and 1.35 tonnes of CO_2 emissions (Appendix IX).

1.12 Impact of Research and How it Will Improve Practice.

The impact of this research will be the way in which it changes how universities and colleges operate. Ideally, institutions will ensure that stakeholders are fully engaged and committed to implementing green ICT initiatives throughout the duration of ICT improvements. The aims of ICT projects will be made clear and communicated to all stakeholders with each participant understanding their role and the impact it has on the broader project. The effects of wasted time and public money will be highlighted and after recommendations are taken on board, significant carbon and cost savings will be made. Ideally this research should be read by university managers at all levels and responsibilities, as its application is multidisciplinary and outlines the importance of stakeholder engagement in greening projects across campus.

1.13 Summary

Barriers to operating more sustainably exist in most FHE institutions and while this is well documented, less well documented is how easily those barriers can be overcome, particularly when implementing sustainable ICT initiatives. It is the responsibility of university managers of all types to understand each of the barriers, how they underpin one another and the role they, as managers, will play in overcoming those barriers. This research will show how using a smartphone to access a web–based app that both records and reports energy wastage – the Energy Detectives web app – might offer a solution to overcoming those barriers. Forward-thinking managers should have a good understanding of how institutions are likely to change as they adapt to changes in government, pedagogic trends, sources of funding, the economy and the various organisations that govern the sector. Understanding the culture and populace of their staff and student community and addressing changes in further and higher education in the UK will become central to the sustainability (financial and environmental) of every institution.

Electronic and manual searches indicate that no research has been conducted into the identification of barriers to universities and colleges participating in sustainable ICT projects – especially where the Scottish Carbon and Energy Management project and the UK SUSTE-TECH project were the focus. While the use of ICT to reduce energy is well documented, no research has been conducted on how ICT can help overcome any of the seven barriers identified in this project. In this respect, there is no extant knowledge on these two subjects combined and therefore a gap exists in the knowledge of this subject. In testing the theory and answering the research question and sub-questions, this research fills that gap and in doing so will equip university and college managers with the capacity to manage their institutions more efficiently. Table 1.2 below outlines the structure of this thesis and the purpose of each chapter.

Table 1.2 Structure of the Research Thesis.

Chapter Number	Chapter Heading	Scholarly Contribution
1.	Introduction.	Setting the context for the research.
2.	The Contextual Background to this Research.	Covering all topics relating to the research: the higher education sector, sustainability, ICT, sustainable ICT, barriers to implementation of green ICT initiatives etc.
3	Methodology.	Justification of paradigms, methodologies, research methods, data collection methods etc.
4.	Sustainable ICT Projects: The Case Studies.	Introduction to The Scottish and UK ICT projects. This chapter is central to the research and reports on the outcomes of both projects. (The Stage 1 of this research).
5.	Analysis of UK and Irish Survey Results.	Results of the UK and Irish Conceptual Framework survey, demonstrating its support of the theory and evidencing each of the seven barriers in universities and colleges. Comparison of both sets of results in three different ways to ensure triangulation of data. (The Stage 2 of this research).
6.	The Energy Detectives Web App.	Demonstration of the creation of an ICT based solution to overcoming some of the barriers identified. (The Stage 3 of this research).
7.	Discussion and Conclusion of Research Findings.	Demonstration of the researcher's ability to revert back to the original research question and sub-questions and offer a conclusive study regarding the overall aims and objectives of the research that is central to a doctoral level study. Listing a series of recommendations to ensure similar barriers are avoided for future projects, ICT or otherwise and advice to government organisations that monitor the UK FHE sector.
8.	Overall Conclusion to Research: Identifying and Overcoming Barriers to Implementing Sustainable ICT in the UK FHE Sector.	Overall Conclusion on overcoming barriers to implementing sustainable ICT in the UK and Irish FHE Sector.

Chapter 2: The Theoretical Background to this Research.

2.0 Introduction.

This chapter commences with a short synopsis on the origin of higher education, which dates back to the ninth century and explains the importance of universities and colleges to the economy and to society. It also highlights how further and higher education institutions provide a hub of employment and activity in their host town or city. A section on environmental sustainability is also included, as are subsections on sustainability within the FHE sector. This chapter also includes a section on Information Communications Technology (ICT) and its use in higher education. It covers our increasing pedagogic and operational reliance on it and discusses the advantages of its use to the workforce. Subsections on sustainable or “green” ICT are included along with an explanation of how and why certain technological features are greener than others. Helping to put this research into context, sections on national and international university agreements, signed by senior university managers who have committed to operating their institutions as sustainably as possible, and to the apparent demise of those agreements, are also included. So too are sections on national and international organisations whose remit is to support institutions as they endeavour to operate more sustainably. Sector recognition in the form of awards and positioning on league tables are also reviewed offering the reader a better understanding of environmental practices within the sector.

2.1 The History of Universities and Colleges

The word *university* is derived from the Latin phrase *universitas magistrorum et scholarium*, which roughly translates into "community of teachers and scholars”. It is an institution of higher education and research that grants academic degrees in a variety of subjects and also provides postgraduate and in some instances undergraduate education (Colish, 1997 pg. 267). In which exact year the first university was founded is still unclear (Pedersen, 2009). Even though much research has been carried out on the topic, results are not conclusive and vary in both dates and origin. Some research indicates that the earliest universities developed in Salerno in Italy during the ninth century (Academic Apparel, 2011) and in Bologna in the eleventh century (Hunt, 2008 pg.56). The University of Oxford in the UK was founded in the ninth century by Alfred the Great (De Ridder-Symoens, 2004) making it the oldest in the UK, while one of the oldest educational academies

in the world, the University of Paris, evolved from Plato's Old Academy in Athens and dates as far back as 387 BC (The University of St. Andrew's, 2011; Pedersen, 2009).

Despite the uncertainty surrounding the exact date and origin of the first universities, it is widely accepted that they started as scholastic organisations or "guilds" and by the end of the twelfth century had extended to most of the larger European cities (Academic Apparel, 2011). By this time universities were considered to be of international importance and began to call themselves *studia generalia*, or places to which scholars from all parts of Europe gathered (Ruegg, 2003). By the end of the nineteenth century, the German university model (which focused on the importance of freedom in research, attendance at seminars, and laboratory practice) had spread around the world (Anderson, 2004). Into the twentieth century universities concentrated on teaching science subjects and became increasingly accessible to the masses. In the UK, the move from the industrial revolution to modernity saw the arrival of new civic universities that particularly emphasised the importance of teaching science and engineering. It is this ethos of transferring knowledge and skills that has remained constant over the centuries and is what we recognise today as a modern university (Anderson, 2006; The National Archives, 2011).

2.2 Universities.

Universities typically are larger in size, are more established, are awarded more funding and are often considered to be more prestigious than a college. Historically, attendance at a university was the preserve of the privileged, but in later years it changed to being open to those less privileged, but who also possessed an academic ability thus ensuring fairness and openness (Her Majesty's Stationery Office, 1963). Some universities offer three-year degrees, but higher education degrees take an additional two to five years depending on the subject and level of research. In 2016 there were approximately 143 universities and 371 colleges in operation in the UK, each providing further and higher education to more than 2 million full- and part-time further and higher education students and employing almost 404,000 staff (Higher Education Statistics Agency (HESA), 2016; Skills Funding Agency, 2016). Higher education in Ireland is provided by seven universities, fourteen institutes of technology, and seven colleges of education. More than 113,700 students in total attend higher education in Ireland and the sector employs almost 14,200 people (Irish Universities Association (IUA), 2015). In,

addition, a number of other Irish third-level institutions provide specialist education in fields such as art and design, medicine, business studies, rural development, theology, music and law (Department of Education and Skills, 2017) proving that universities are an integral part of society that have the critical mass required to affect sustainable change.

2.3 Further and Higher Education Colleges.

Colleges are typically smaller than universities in size and have only been in existence in the UK since the 1950s (Board of Education (BOE), 1943). They were created to provide people with skills that would aid in the rebuilding of their country after the Second World War. They also allowed students from a less privileged background to obtain a tertiary education and develop a skill set that would help them gain employment (Gillard, 2011). Colleges found across the globe have similar criteria and objectives to universities, namely the obtainment of a higher level of education, but their entry requirements are usually less stringent (Which?, 2015).

In the UK and Ireland, colleges are categorised into either further or higher education institutions. Further education typically involves post primary education and covers a range of subjects taught at a lower educational level. UK and Irish higher education colleges offer a similar range of subjects, taught at a higher level with many colleges teaching both higher and further education courses simultaneously (Association of Colleges (AOC), 2016; Department of Education and Skills, 2017).

Likewise, in Australia and the U.S., technical colleges and community colleges offer vocational training and teach courses in a wide range of subjects at a lower level including business and finance, hospitality and tourism, construction and engineering, and humanities and the arts. Their main aim is to provide affordable education and training via an "open door policy" with low tuition costs and few entrance requirements offering a pathway into higher education. (National Centre for Vocational Education Research (NCVER) 2017; TheBestSchools, 2017; American Association of Community Colleges (AACC), 2017; AOC, 2016). Despite this, colleges still have plenty to offer in terms of participation in sustainable projects and engaging in more sustainable behaviours. In fact, if anything colleges are more likely to do so as they tend to be more goal-orientated (Marti, 2014).

2.4 The Potential Impact of FHE Institutions in 2016–2017.

In 2016, the total number of students enrolled in either further or higher education courses in the UK was almost 2.5 million with more than 198,000 employed in teaching and research and more than 205,000 employed in the operational side (HESA, 2016; Skills Funding Agency, 2016). In Ireland, the total number of people in third-level education at the last count was 217,520 (Higher Education Academy (HEA), 2017) with 17,326 core staff employed, 52% of whom are academic, the remaining 48% being support and administrative staff (HEA, 2017). Globally, it is in the region of 183 million students with that figure forecast to more than double to 262 million by 2025 (Malsen, 2012). Even in 2016, universities' core business is still teaching and research but there is increasing pressure to engage with business and to source funding from as many different streams as possible (Clarke, 2004). Twenty years ago the majority of university funding came from donations and government organisations; in 2016 it is mainly from increased tuition fees and any financial gains associated with engaging with businesses or funding from the EU (Blake, 2010; IUAb, 2015). Governments have left FHEs to manage their own financial and academic affairs (Collini, 2012).

The cause of this change in dynamics can be attributed to the 2010 global recession, where funding for education and research in the UK was cut by £600 million. Since then the argument for the survival of the UK's economy being dependent on the outputs from universities and colleges has been reiterated. The government has been reminded of the role that FHE institutions play in developing skills, innovation and the knowledge economy in what has become an increasingly competitive global environment (Universities United Kingdom (UUK), 2011; 2016; HEA, 2010; HEFCE, 2010). This development in innovation and expansion of the knowledge economy was made clear in 2014 when it was reported that the UK higher education (HE) sector contributed more than £73 billion and more than 750,000 full-time jobs to the UK economy during the 2011– 2012 period, equating to 2.8% of gross domestic product (GDP) (UUK, 2014; UUK, 2015; GOV.UK, 2014b). In Ireland it was in the region of €10.6 billion (£7.8 billion) a year and supports 150,000 jobs (Grove, 2015).

Regardless of sources of funding, size of population of campus, reputation or geographical location, universities and colleges are firstly educational institutions of tertiary level. For this reason they should not only facilitate in teaching and learning

but also offer opportunities to gain first-hand experience in practical sustainability as well as being exemplars of sustainable best practice themselves. Universities and colleges are educational institutions employing intelligent and academically qualified staff. Many are associated with leading in innovation, commercial development and continuous professional development, yet simple and hugely beneficial initiatives (environmental or otherwise) often go un-implemented (Clarke, 2004; Tahseen, Karney and Sinclair, 2015; Bawden, 2015). This research focusses on "barriers to implementation", how and why it occurs and what institutions can do to overcome any barriers to it, and operate more sustainably. Understanding the basic principles of sustainability is key to improvement, as is understanding how the sector operates as well as being aware of the various organisations that exist to aid institutions in their attempts to be greener.

2.5 Sustainability.

The concept of living within environmental boundaries has been understood for centuries. In fact, Plato (347–427 BC) was one of the first scientists to acknowledge that: "*land must be extensive enough to support a given number of people in modest comfort and not a foot more is needed*" (Wackernagel and Rees, 1996, p.37). Some environmental laws that are still in effect today date back as far as the seventeenth century (Department of Health and Environmental Control (DHEC), 2017). Preservation of natural resources and protection of the environment may have been in existence for centuries, but the sustainable revolution being experienced today only started to gain real momentum in the 1970s when the United Nations Conference on the Human Environment took place in Stockholm, Sweden. This conference was a turning point for sustainability as the ecological limitations of the planet were finally being recognised as an urgent issue (Edwards, 2005*)*. From this conference came the Brundtland Report which described sustainable development as "*development that meets the needs of present without compromising the ability of future generations to meet their own needs*" (United Nations Commission on Sustainable Development (UNCSD), 2007).This definition has since become widely accepted as the official definition of sustainable development (World Commission on Environment and Sustainable Development (WCESD), 1987). The Brundtland Report, officially entitled *Our Common Future*, not only gave the definition of sustainability but created the framework for concerted action to protect the earth's natural resources while also supporting both economic and social justice goals. The report addressed the importance of combining environmental protection with

economic growth and highlighted how inseparable the two issues are (Edwards, 2005*)*. By 2016, almost thirty years later, sustainability's remit has expanded to incorporate the use of technology, social activity, government bodies, financing organisations and research institutions, each inextricably linked to one another (Roberts and Roberts, 2007). From the 1994 Rio Summit, the sustainable framework, Agenda 21, was born and the practice of dematerialisation was encouraged (United Nations (UN), 2007). However, despite the expansion of sustainability into our everyday lives, we appear to be counteracting any green savings created by continuing in an ever-increasing trend of population growth and our excessive consumption of material goods (Hamilton, 2009; Erlich and Erlich, 2008). We fail to consider the embodied energy required to create, use those items to ensure they last the duration of their life-cycle and the inevitable waste all of this consumption creates (CircularEcology.com, 2016; DEFRA, 2017).

2.6 Consumerism and Waste.

Consumerism has always played an essential role in the development and sustainability of the world's economy. It allows for growth in innovation and expansion of businesses and creates employment. The consumption of certain goods and services, such as energy, water and food, is essential to human sustenance and to maintaining a modern lifestyle at a reasonable level of comfort. In fact, life in the twenty-first century is centred around it (Shukla, 2009; James, 2007). However, consumerism has changed in the last century from an activity that, at one time, solely met our basic needs for survival, to one that met our material needs to one that, in the twenty-first century, plays a significant role in our personal identity (Hamilton, 2009). This level of consumerism has led to an exorbitant amount of waste being created (DEFRA, 2017). Fortunately, this issue is being tackled.

The list of consumable items than can be recycled has expanded to include electronic waste, energy, furniture, clothing and textiles. People are encouraged to reduce, reuse and recycle in their schools, homes and workplaces in an attempt to reduce their carbon footprint (WRAP, 2016; RecycleNow, 2016). Governments and large organisations are acknowledging that while creating waste is almost unavoidable, they also view it as an opportunity to create savings. Tackling climate change via waste minimisation has become part of their manifesto and universities and colleges have done the same (Sustainability Exchange, 2016a; 2016b; WasteRecycling.org.uk, 2012).

As the public enthusiasm for greener ways of life grows, the sustainability culture has become a social practice. It has become an instrument of knowledge formation as it engages with new and emerging social values (Parr, 2009, p.3). This is increasingly evident in institutional use of greener technologies that not only have smaller carbon footprints and require less energy to run but allow us to engage with one another in reaching a common goal. That common goal is improved sustainability in campus operations (EAUC, 2017).

2.6.1 Dematerialisation.

Dematerialisation refers to the reduction of materials flow of goods and services within the environment (Van Oers, Kleijn and Van der Voet, 2002). It involves reducing material use intensity, by minimising the need for physical materials (UNCSD 2007; Duchin and Hertwich, 2003). It is often described as the development where material use per unit of income (or a certain service) declines (De Bruyn, 2000). Two types of dematerialisation are recognised, relative and absolute, and both are dependent on each other (Cogoy, 2003). Economists refer to them as the relative or absolute reduction in the quantity of materials required to serve economic functions in society (Iddo et al., 1996).

2.6.2 Relative Dematerialisation.

Relative dematerialisation refers to the reduction in the flow of materials and energy per unit of output (Cogoy, 2003). This equates to a reduction in raw materials and energy consumed in the manufacture of a product or provision of a service. An example is the use of thin client technology as part of an ICT system instead of thick client (thus using fewer and smaller pieces of equipment) or the use of more sustainable sources of energy in its manufacture and use. With relative dematerialisation, the reduction of environmental impacts can be monitored and calculated and can be directly correlated to an increase or decrease in energy consumption and therefore an increase or decrease in wasted energy (Cogoy, 2003).

2.6.3 Absolute Dematerialisation.

Absolute dematerialisation refers to the final resultant dematerialisation after the economy has adapted to the original increases in ecological efficiency and overall environmental output is reduced. It is considered the overall increase in environmental efficiency created through the dematerialisation of a series of products or services (Cogoy, 2003; Van Oers, Kleijn and Van der Voet, 2002). Both forms of dematerialisation are inseparable in so far as absolute dematerialisation cannot occur unless relative dematerialisation is first practised. Absolute dematerialisation in an FHE institution requires the combined effort of each participant and component in the life-cycle of a product or service to be successful (Cogoy, 2003; Van Oers, Kleijn and Van der Voet, 2002). However, it is essential to understand that that absolute dematerialisation cannot occur if one form of resource use is substituted for another. For example, if the purchase of newer pieces of ICT equipment with smaller ecological footprints requires more energy to operate and could not be recycled, absolute dematerialisation, and subsequently, true sustainability would not occur. Being mindful of absolute dematerialisation is therefore essential when attempting to live within our environmental footprint. It also plays an important role in sustainable development as it helps to relieve the constraints to economic development, caused by the scarcity of materials and ensures that exhaustion of natural resources can be delayed (Femia, 2014). Tsvetkova, (2014) argues that what is really required to ensure sustainable development is radical innovation that disrupts current systems, brings new, greener technologies into operation and restructures the unsustainable modes of production. This, however, requires a larger system-wide effort where sustainable innovations are marketed using a business model perspective that will bring greener innovations to the market (Boons and Leudeke-Freund, 2013).

2.7 Sustainability in Universities and Colleges

David J. Eagan et al. (2008) stated that:

> "*If any society has the potential to model the transition to a low-carbon future, it is higher education. With their depth of expertise, innovative research and societal influence, colleges and universities have been at the forefront in addressing global warming".* (Eagan et al., 2008, p4).

In the 1990s, FHE institutions started making environmental sustainability central to their campus operations.

Commencing with the drafting of environmental policies, they started to examine and reduce their impact on the environment (De la Cour, 1995; Hinde, 1998). Unfortunately, other institutions did not and several of them still continue to underperform where environmental efficiency is concerned (People and Planet, 2016). As universities are typically long-lived institutions, investing time and money into a robust environmental framework that prioritises the reduction of resources and increases environmental efficiency, will prove frugal and socially responsible (Hammond-Creighton, 2006). Worldwide participation of universities and colleges in actively achieving campus sustainability was started in 1990 when the Tallories Declaration was drafted and signed. As sustainability is essentially a social learning process that is interdisciplinary and crosses the boundaries between politics, science, engineering, social studies and business subjects, campuses are a place where innovation and experimentation can occur. Staff and students can become willing participants and the campus grounds often serve as living laboratories (University of Cambridge, 2017). FHE institutions are ideal places for students to learn about such integration, innovation and experimentation. They are also ideal places for students to experience community participation and foster social learning skills that are based on the interaction between local authorities, academic and non-academic staff and community organisations (Hogan, 2009; Barry, 2007).

Unfortunately, this is not always the case. Research had shown that universities seem to be “generally lacking” when it comes to practising sustainability (Alshuwaikhat and Abubakar, 2008). Even in universities where concerted action in campus “greening” had taken place, there was ample room for improvement (People and Planet, 2006; People and Planet, 2016; STARS, 2016; EAUC,2015b; Hammond-Creighton, 2006; Barry, 2007). More concerted action focussing on how to realistically and practically achieve campus sustainability should be as central to an institution’s culture as writing lectures, designing courses and increasing the number of publications (University of Surrey, 2008; Barr, 2004; Alshuwaikhat and Abubakar, 2008).

2.7.1 Universities’ Commitment to Operate More Sustainably.

By the 1990s universities across the globe had started to make official their commitment to operating more sustainably. This commitment included not only the

day-to-day campus operations and management but teaching and researching too. Declarations, treaties and agreements were signed and reports were written committing to environmental sustainability through best practice at an institutional level. Four of these statements of commitments are included below.

2.7.1.1 The Tallories Declaration of 1990.

The Tallories Declaration was a declaration signed in 1990 by senior members of staff at almost 500 universities (presidents, rectors, chancellors and vice-chancellors) including thirteen UK institutions and one Irish institution, confirming universities' commitment to environmental responsibility (University Leaders for a Sustainable Future (ULSF), 2016a). It stated that the signatories were deeply concerned about the unprecedented scale and speed of environmental pollution and depletion of natural resources. It also stated that environmental changes were caused by inequitable and unsustainable production and by consumption patterns that contributed to poverty in poorer regions of the world. The declaration also stated that urgent actions were needed to address the fundamental problems and reverse unsustainable trends. It also stated that universities have a major role to play in education, research, policy formation and information exchange to make these goals possible (ULSF, 2016b). A year later the Halifax Declaration was signed.

2.7.1.2 The Halifax Declaration of 1991.

The Halifax Declaration was created at the conference on University Action for Sustainable Development at Dalhousie University, Nova Scotia, Canada in 1991. Thirty-three universities from ten countries on five continents met to take stock of the role of universities regarding the environment and development. They were joined by a number of senior representatives from business, the banking community, governments and non-governmental organisations. Signatories agreed that if a university was to provide environmental leadership it must first set its own house in order (Clarke and Campbell, 2000, pp.1–39). In fact one of its co-authors and a professor of environmental science at the University of Calgary, Canada stated that:

> "*Universities and colleges have important roles as educators, researcher institutions, sources of new technologies, methods and skills, role models and leaders in change. As the setting for the education of future*

professionals and leaders, the milieu that universities provide for that education must be consistent with the knowledge, skills, ethics and morals they are imparting. They also have responsibilities to the communities, governments, other institutions and industries that support them" (Thompson and Van Bakel, 1995).

2.7.1.3 The Toyne Report of 1993.

The Toyne Report was written by Professor Peter Toyne, Vice-Chancellor and Chief Executive of John Moore's University (JMU), in the UK and published in 1993. Prof. Toyne wrote the report after chairing a committee established by the UK Government Department of Education to investigate the potential for greening higher education. It was JMU's first serious attempt at managing its environmental responsibility and initiating sustainable practice on campus. The report suggested

> *"every further and higher education institution adopt a comprehensive environmental policy statement, together with an action plan for its implementation, by the end of the 1994–95 academic year".*

Energy, transport and purchasing policies were targeted by JMU for "greening" and the university's procurement policy was amended to give preference to items (services, materials, equipment and consumables) produced in ways that caused least harm to the environment. Where possible, local or regional suppliers were given preference to reduce the carbon miles and where JMU already required minimum packaging from its suppliers, goods were to be sent back in incidents of non-compliance. University staff, student and visitors were encouraged to use more sustainable modes of transport and the university's fleet of vehicles were, where practicable, modified to minimise pollution and make more economical use of fuel. A campaign was proposed for cycle paths linking campuses and other student facilities and interest-free loans for staff wanting to buy season tickets for public transport or for the purchase of a bike was initiated.

Energy-efficiency initiatives included the monitoring of energy use and targeting areas of wastage. In 1993 the university already had an environmentally-responsible approach to new buildings or refurbishments, but this was amended to include new buildings being able to demonstrate the use of sustainably-produced materials and construction methods that make optimum use of resources

(THE, 1995). The Toyne Report, was so well received that it evolved into Toyne II and III – revised editions of the first report (Kahn, 1996).

Shortly thereafter, the Environmental Policy and Action Plan (EPAP), which was established in 1994 to fulfil the recommendations of Toyne I, became the stimulus for a number of critical decisions made by the executive in the years that followed (ULSF, 2016b).

2.7.1.4 The COPERNICUS Agreement of 1994.

Written in 1994, the COPERNICUS Agreement was yet another university declaration to their commitment to sustainable causes. The word COPERNICUS is an abbreviation for Co-operation Programme in Europe for Research on Nature and Industry through Coordinated University Studies. Originally designed by the Conference for European Rectors (CER), its principal aim was to bring together experts from European universities, from industry and research and from non-governmental organisations as well as other concerned sectors of society to a better understanding of the interaction between man and the environment and to collaborate on satisfactory and long-ranging solutions (United Nations Educational, Scientific and Cultural Organization (UNESCO),1994). Another aim of the Copernicus Agreement was to achieve a partnership capable of providing concrete assistance for the problems identified, notably in relation to better training, research and information exchange (UNESCO,1994). Additional aims of the Copernicus Agreement included incorporating environmental perspectives into all university education and developing teaching materials to that effect. It also aimed at promoting and coordinating integrated multidisciplinary and collaborative research projects and sharing research findings with economic and political decision-makers (Wright, 2002).

2.8 Universities Leaders' Statement of Intent for Sustainable Development.

In an attempt to start a renewed sense of improvement in sustainable performance and development in HEIs and to support and strengthen the four agreements that preceded it, the Universities UK (UUK) launched a Universities Leaders' Statement of Intent for Sustainable Development (UUK, 2010). Published in October, 2010, the three-page document opens with a reminder from John Foster that universities "should be thinking hardest about the implications of the whole world-system for our

common life and its future, and bringing the best of our available intelligence to bear on the necessary changes". Later that year Professor Colin Lawson of the Royal College of Music (RCM) signed the People and Planet's Green Education Declaration committing UK universities to meeting the challenges of sustainable development. It stated that universities were in a unique position to support society by being innovative, by transferring knowledge through research and by teaching and learning (GuildHE, 2010;RCM, 2010). It also stated that universities could meet the challenges of sustainable development through their organisational activities as campus managers. However despite the declarations, agreements, treaties and reports written, there is a distinct lack of progress regarding sustainability across the sector.

2.9 Current State of Sustainability in Universities and Colleges.

Overall consensus from sustainable organisations such as the EAUC, People and Planet, AASHE etc. is that while many institutions sustainable performance is outstanding, still more are struggling to implement basic initiatives (Suryawanshi and Narkhede, 2015; EAUC, 2015b; People and Planet, 2015; STARS, 2015). For this reason identification of any barriers to optimal sustainable performance, ICT or otherwise, and a follow-up action plan on how to tackle and overcome those barriers is imperative. The use of technology in 2017 to overcome those barriers appears to be one of the more engaging and successful ways forward (Hilty et al., 2006). The use of smartphone apps and social media in tackling energy waste in particular is proving increasingly popular (Crowley, Curry and Breslin, 2014; Hamid et al., 2016). This research features a smartphone web app that did exactly that.

2.10 Energy Use in UK FHEs.

There appears to be a lack of consistent data relating to energy use for the UK FHE sector that allows for a clear, year-on-year comparison of both running cost and carbon emissions. For example in 2016, The Carbon Trust reported that the total energy consumption for the UK FHE sector was £400 million and created 3.1 million tonnes of CO_2 emissions, but failed to state which year this data was referring to (Carbon Trust, 2016b). However, in the 2008 sector review of UK higher education energy consumption, Ward, Ogbonna and Altan reported that the total energy

consumption of HEIs was in the region of 706.23Ktoe or 8.2 million kWh for 2006. No financial metric was given in the report, nor did it include data from FE institutions. The Higher Education Statistics Association's (HESA) estate management records, AUDE, The Carbon Trust and HEFCE's websites contain text committing to the UK government's national target of a 34% reduction of CO_2 emissions by 2020 (against 1990 levels) and of 80% by 2050 (Legislation.GOV.UK, 2011) but have not published comparable tabulated data relating to energy consumption for the sector.

However, a likely reason for this lack of comparable data may be due to changes in the size, structure and energy requirements of FHE institutions since 1990. As the number of students entering the FHE sector has steadily increased, reaching more than 2 million in total by 2016 (HESA, 2016), the use of technology and electrical devices has also increased, making any clear comparison of data almost impossible. Despite the lack of a comparable annual carbon report from the sector, it is generally acknowledged that energy consumption in UK FHEs has steadily risen since 1990 (Ward, Ogbonna and Altan, 2008; Carbon Trust, 2016a). Any reduction or stagnation of CO_2 emissions in the sector is likely to be as a result of the switch to a more renewable, cleaner energy mix. Where previously coal, gas and electricity were the main sources of energy to the UK market, since the new millennium it has changed to a mixture of CHP, solar and incineration of waste etc. (Ward, Ogbonna and Altan, 2008; Carbon Trust, 2016a). Any improvements in energy efficiency across UK campuses are mainly due to management attempting to mitigate rising costs of energy coupled with institutions' responsibility to operate in a financially, as well as environmentally, sustainable manner.

Institutions are regarding environmental initiatives as being essential cost-savers and not just carbon reduction features (Lyons-Hardcastle, 2013). For example green ICT can significantly contribute to energy savings in two ways; greener ICT requires less energy to operate (James and Hopkinson, 2009) and by utilising the latest ICT monitoring technologies institutions can identify, report and stop energy wastage as it happens (NTU, 2015). They are utilising less energy-intensive technology that also reports energy use and corresponding carbon emissions as well as automatically powering down/switch off when not in use (JISC, 2014a). Even energy awareness campaigns targeted at students appear to also be making a difference (National Union of Students (NUS), 2016).

However, the institutional requirement for more space continues to increase. Estate managers are continually looking for new ways to “sweat their assets” favouring a greater number of activities in buildings, for longer hours, during evening and weekends and especially outside of term time (Association of University Director of Estates (AUDE), 2016 Goldsmiths, 2016b). Combined efforts of estate management teams to improve energy efficiency have reduced the sector’s carbon footprint and without such improvements nearly 1.2 billion kgs of additional carbon dioxide would have been released (UUK, 2015). Despite these carbon savings, there is still room for improvement. Research conducted in 2012 indicated that on average 20% of FHE energy use is wasted in the form of heat escaping through poor insulation (The Carbon Trust, 2012). Inefficient plant equipment, short-sighted design and layout of buildings and wasteful behaviour of end users also contribute to energy waste (Beggs, 2002). The UK government has made strides to curb wasteful behaviour and institutions participate in programmes that remind stakeholders to power-down, switch off and unplug when not in use (NUS, 2016; Energy Saving Trust, 2016; Gray, 2008).
One of the areas of energy consumption within the sector that has improved, despite extensive growth, is ICT (Suryawanshi and Narkhede, 2013). This improvement is primarily due to the use of more sustainable ICT equipment. However, before such improvements can be made, barriers to implementing sustainable ICT initiatives needed to be identified and overcome, which are some of the aims and objectives of this research.

2.11 Information Communication Technology (ICT).

Information Communications Technology (ICT) is an enormously complex and fast-growing field (Kramer, Jenkins and Katz, 2007). While the idea of communicating electronically dates back to 1876 with the patenting by Alexander Graham Bell of the telephone (Bellis, 2015) it has only in the past twenty years become so ingrained in our daily lives that without it we are at a loss (Crabtree, Nathan and Roberts, 2010). There are few areas of daily life that do not involve the use of technology and education is no exception. Classrooms and lecture theatres are typically equipped with computers, whiteboards and AV equipment of various sorts, each playing an important role in communicating. ICT is also essential to the day-to-day running of FHE institutions where it is used for administering payroll, scheduling timetables, maintaining staff and student records, tracking finances and e-mailing (Great Value Colleges, 2015; Kolbitsch, 2014). As ICT use becomes more essential to daily life,

not surprisingly, it is accompanied by a financial and environmental costs (Rivard, 2013; Soltan, 2015). These costs are increasing year on year as new technologies and software packages are constantly being created and updated. Eager to stay current and offer staff and students the latest in ICT services, FHE institutions routinely upgrade their ICT systems but are often restricted by budget constraints (Appendix I; JISC, 2014c). This in turn creates ongoing purchasing expenses and a continuous stream of e-Waste (Dodds, 2014; Tso, 2013; EAUC, 2011b).

Research carried out in 2009 estimated that ICT use in UK HEIs involved the use of 1,468,000 computers, 246,000 printers and 238,000 servers (amongst other ICT equipment). All this “kit” emitted more than 500,000 tonnes of carbon dioxide and cost UK FHEs approximately £116 million in ICT-related electricity costs (James and Hopkinson, 2009). A 2012 report put the annual ICT energy expense to UK universities and colleges at £147 million (Hopkinson and James, 2012).

Finding that ICT electricity costs could represent as much as 57% of total electricity costs is not surprising given the energy consumption of ICT-intensive research labs. FHE imaging equipment, for example, can consume up to 19% of ICT energy and audio-visual equipment as much as 21% (Hopkinson and James, 2012).

Even the extraction and processing of materials that go into the manufacture of ICT equipment has a very heavy environmental footprint. A study carried out in 2007 (IVF, 2007) showed that a European PC and 17” monitor weighing about 20kgs will create an estimated 37kgs of non-hazardous waste and 0.7kgs of hazardous waste. It will also require 3,244 megajoules (MJ) of energy to manufacture along with 920 litres of process water and 193 kgs of greenhouse gasses. Over the course of its life-cycle a PC will also release heavy metals and contribute to acid rain and other air, soil and water pollutants. PCs alone are responsible for approximately half of the UK’s HEIs ICT-related energy consumption (James and Hopkinson, 2009). Digital printing accounts for a further 10–16% of ICT-related energy use and up to 80% of HE office waste (James and Hopkinson, 2009; Hogan, 2009). However, educating and researching via the use of technology has become so deeply ingrained in modern pedagogic methods that removing it would be almost impossible as well as being disadvantageous and unnecessary (Bates and Poole, 2003; Bokoer, 2012). As the general consensus is that technology is here to stay, the move is now toward manufacturing, using and disposing of it more sustainably (Stephens, 2012; Foster, 2011). This research does exactly that, focussing on the barriers to green ICT’s implementation and use.

2.11.1 Sustainable ICT.

Sustainable or greener ICT has been described as:

> "*a pioneering way of using ICT that consists of policies and practices which deal with environment sustainability by minimizing carbon footprint, by optimizing energy consumption and by conserving natural resources for cost effectiveness*"
>
> (Suryawanshi and Narkhede, 2015, p.3).

It has also been described as:

> "*(i) the systematic application of ecological-sustainability criteria to the design, production, sourcing, use and disposal of ICT technical infrastructure (ii) as well as within the human and managerial components of ICT infrastructure in order to reduce ICT, business process and supply chain related emissions, waste and water use; improving efficiency and generate green economic rent".*
>
> (Molla, 2009 via Wabwoba, Wanyembi and Omuterema, 2012, p.3).

It follows, then that ICT equipment is now being designed, manufactured, used and disposed with the earth's finite resources in mind (Velte, Velte and Elsenpeter, 2008). ICT equipment is being manufactured in smaller sizes, requiring fewer production materials that require less energy to operate (GreenICT.org.uk, 2016; Hickman, 2010). ICT equipment has longer life-cycles, and after reaching their end of warranty can be reconditioned for reuse (UnigreenScheme, 2017) or donated (ComputerAid, 2016). In addition, ICT energy and carbon accounting tools are available (ForumfortheFuture, 2017) as well as procurement information relating to the most sustainable and energy efficient pieces of ICT equipment (SusteIT, 2016; London University Purchasing Consortium (LUPC), 2013; Energy Star, 2016; Epeat, 2016). For example, data centres are becoming smaller and more energy-efficient and are capable of multitasking (FutureoftheDataCenter, 2013). Some are being virtualised and others are based almost entirely in the cloud thus almost entirely eliminating the use of on-site data centres entirely (Speake, 2011; Milner, 2011; Appendix IV, Appendix XVII). This saves on running costs and associated costs such as space, IT staffs' time and cooling costs. PCs are being replaced by smaller, lighter "notebooks" that have built- in power-saving features and have a lighter ecological footprint (Apple, 2017).

Multifunctional printing and copying devices (MFDs) that contain print and energy management features are replacing thousands of individual desktop printers across institutions, thus reducing energy and paper use and creating savings (Lee, 2011; Hewlett Packard, 2014; Cheetham, 2010). Green ICT is also being adopted in businesses and in government as a means of saving money and reaching carbon targets as well as setting a good example of best practice.

2.11.2 Sustainable ICT in Government and Business.

In 2011, the U.K. government set out to achieve ten improvements to its green ICT practice by the end of 2014–15. Their plans included using more efficient data centres and recycling much of its computer hardware, which was part of its four-year implementation plan to reduce the environmental impact of its ICT estate by making it more energy-efficient (Say, 2011). The UK government's greener ICT plan would also examine procurement, energy management, consolidation, print services, network rationalisation, supply chains, use of apps, data centre efficiency, storage rationalisation and recycling as well as examining better ways of working. For example the Foreign and Commonwealth Office (FCO) planned to reduce running costs by 30% –40%, while at the same time reducing their environmental impact and providing better services to staff (Guardian Government Computing, 2011). The Department of Transport's emissions level fell in 2010 after an IT-enabled active traffic management system was piloted on a stretch of the M42. The pilot scheme demonstrated how opening the hard shoulder to peak time traffic improved reliability and reduced the number of accidents. The pilot scheme also showed that carbon monoxide emissions fell by 4%, particulate matter fell by 10%, CO_2 by 4% and oxides of nitrogen by 5%. While the emission of hydrocarbons increased by 3%, fuel consumption fell by 4%, so overall environmental improvements via the use of ICT were demonstrated (Guardian Government Computing, 2010).

Examining how to save money and be greener through more efficient use of ICT expanded to include hospitals. Newham Hospital for example virtualised 70% of their data centres and installed NightWatchman, software that automatically powers down PCs when not in use. In total Newham Hospital saved £18,500, making a full return on their investment in less than a year. In addition, this greener ICT project contributed to reducing their carbon emissions by 143 tonnes, equating to 264,552 kWh of electricity. Newham later won the Greenest Hospital award at the Healthcare

Excellence and Leadership Awards and were a finalist in the Green IT awards 2011 (Jeffrey, 2011). NHS Oldham had a similar green ICT plan and also installed NightWatchman as well as Wake-On-LAN software allowing computers to be turned off remotely but also switched on again for software updates. At the time of the initiative, NHS Oldham estimated a saving of £41,000 just from powering off their 350 desktop PCs (SmartHealthcare.com, 2010).

Where businesses are concerned the advantages of implementing greener ICT are the same: significant cost savings, increased office space, diminished travel requirements and an enhanced reputation within the sector (Stanley, 2014). As a greater number of businesses start to move into the cloud and allow staff to work remotely, thereby saving on buildings overheads such as lighting and HVAC etc. (Jennings, 2017) they have also inadvertently created a happier and therefore more productive workforce (GlobalWorkplaceAnalytics.com, 2015). Table 2.1 below summarises the more commonly found sustainable ICT initiatives and lists the advantages of their use.

Table 2.1 Sustainable ICT initiatives and the advantages of their use.

Sustainable Option	Advantages of Use
Duplex Printing and Copying.	Implementing double-sided printing and copying by default on all printers and copiers saves on A4 paper costs, energy costs and printing time. Using recycled paper and scrap paper and switching off printers and copiers when not in use, saves in energy and paper costs.
Video Conferencing and Skyping.	While electronic “face to face” meetings allow for improved productivity due to visual input (as opposed to e-mail or telephone conversation), this technology saves on travel time and costs
Thin Client Technology.	Using smaller, more streamlined, more compact equipment that requires less energy to operate and is often less expensive to purchase.
Cloud Computing.	Utilising cloud computing to deliver computer services over the internet by external service providers such as Google or Amazon saves money as fewer IT support staff are required.

Sustainable Option	Advantages of Use
	These services also have a smaller environmental footprint.
Automatic Shutdown of PCs When Not in Use.	This initiative is often free and highly effective. Many institutions' IT managers have created their own automatic shutdown programme and reported instant energy savings, as computers previously left running 24/7 were only consuming energy when needed.
Virtualization.	Similarly to cloud computing, virtualisation allows data storage and other computer services to be stored off site thus eliminating running costs associated with on-site data centres such as staff and air-conditioning. (Hogan, 2010)

Each of the sustainable ICT initiatives listed in Table 2.1 has proven successful in saving money and reducing CO_2 emissions and other wastes (Sustainability Exchange, 2016d). As there is no single method for reducing energy use, institutions are encouraged to tackle this by employing more than one method (JISC, 2014b). Sustainable ICT measures often have a payback of less than two years (James and Hopkinson, 2009) and can demonstrate a clear reduction in CO_2 emissions and other wastes instantly. However, such technologies are simply not being implemented properly or extensively enough to effect real change. Where they have been, they are not managed to ensure real cost or carbon savings (Shreeve and Curtis, 2012). This is due to barriers within institutions that need to be firstly identified and then overcome. It is also important therefore to implement greener ICT systems into FHEs as soon as possible (Baroudi et al., 2009) to avoid further energy waste.

2.11.3 Sustainable ICT in Universities and Colleges.

Technology is continually advancing and connectivity between electronic devices is ever increasing (Apple, 2017; Microsoft, 2017; Garcia-Martinez, 2016). ICT devices will play an even greater role in daily life over the next few decades (Satell, 2013; Penning de Vries et al., 2015; Schwab, 2016) as the number of mobile devices in use is expected to reach five billion by 2020 (Boxhall, 2015). This essentially leaves much of the environmental responsibility of their use and disposal with the end user. It is also imperative that the end users understand how the utilisation of newer

technologies can aid the continuous measurement, monitoring and improvement of the environmental performance of an organisation. The use of technology to help make a campus more sustainable has started to gain momentum (Ravesteyn, Plessius and Mense, 2014; Erdmann, 2008). Already, sustainable ICT projects carried out in UK universities and colleges from 2009–2012 have demonstrated this (JISC, 2011). Coupled with behavioural change (through ongoing energy use awareness campaigns) and the use of newer technologies, sustainable ICT has played a central role in the wider environmental management of universities' campuses (Carrera and Kurnia, 2015). Some technologies such as motion sensored lighting, automatic powerdown of PCs and thermostats have been in use since the new millennium, but in recent years the use of smartphones as reporting tools and as a means of engaging with staff has increased (Tolias et al., 2015; Carbon Trust, 2016c).

In Singapore, for example, at the University of Nanyang, students are using smartphones to record temperatures in classrooms. Using Nanyang Technological University's (NTU) new mobile app, called the POWERZ app, the central air-conditioning temperature settings can be adjusted, helping the university save on its energy bills. The POWERZ app is part of a wider eco-game where staff and students provide information that is helping the university conserve power by indicating when lights are left on in empty lecture theatres and in venues where the air-conditioning is too cold. The information is relayed to NTU's facilities management department, who will be able to make changes to the settings and conserve energy across campus (NTU, 2015; Carrera and Kurnia, 2015).

However, despite advancements in green ICT, from 2009 to 2015 universities and colleges in the UK were still using older, inefficient equipment and paying exorbitant running costs, unnecessarily (JISC, 2015). Some institutions were restricted by procurement contracts preventing them from choosing a more sustainable piece of equipment (Appendix II and II.1) and many institutions claimed they could not afford the purchase costs of new equipment anyway (Appendix I). Ironically, as research has shown, savings made year-on-year in energy costs through the use of more sustainable ICT equipment can far exceed initial purchase costs (Hogan, 2010; Fujitisu, 2011). In addition, the institutional benefits of utilising sustainable ICT equipment, systems and software are numerous (Worthington, 2010), the most obvious benefit being the financial savings (Fernandez, Procaccianti and Lago, 2015). Consuming less electricity also means releasing fewer CO_2 emissions so carbon targets are also reached, (Carbon Trust, 2016a).

Other institutional benefits include the option of staff being able to work independently from their offices. Technologies such as video and web conferencing and skyping enable staff to work from remote locations and reduces the need for travelling long distances for meetings (JISC, 2011). This saves on transport costs and travel time, can minimise the need for office space and its associated light and heating costs and allow more specialist staff to attend events and meetings that otherwise they could not (Hogan, 2010). However, UK and Irish FHEs appear not to be utilising such greener technologies to the extent they could and should be. Where they are, they are doing it in minimal, piecemeal amounts. This may be due to institutional barriers that need to be identified and ultimately overcome (Shreeve and Curtis, 2012).

2.11.4 Barriers to Sustainable ICT.

Barriers to implementing greener ICT initiatives in large organisations occur for a number of reasons. Wabwoba, Wanyembi and Omuterema (2012) state that some of the barriers include affordable and accessible green ICT hardware, human personnel skills and their qualifications, consultancy, training of managers and users, lack of awareness, education systems review policy, funding, legal framework, lack of consumer demand and poor decision-making process in organisations. They also add that resistance to organisational changes, especially in connection with older human personnel, is a barrier. This hampers decision-making when implementing greener technologies and in certain circumstances such decisions are made with short-term solutions in mind rather than long-term ones, thereby inhibiting sustainability. Similarly, Molla and Cooper (2009) discussed barriers to organisations being “G-ready”; being ready to implement greener ICT initiatives in their organisations and businesses. They argue that there are at least five important factors for success in greening IT; attitude, policy, practice, technology and governance. They argue that together these factors create the critical capability of “G-readiness”, the absence of which may be considered a barrier.

2.11.5 Barriers to Sustainable ICT in Governments and Business.

Barriers to sustainability exist across all business sectors. As organisations strive to become greener they appear to face similar barriers to that of implementation of ICT initiatives. For example in the Nigerian construction industry a lack of resources, supplier resistance to change and a lack of awareness were found to be the main barriers to adoption of a greener supply chain management. Qualitative research carried out by Ojo, Mbowa and Akinlabi in 2014 interviewed participants from both public and private constructions firms via a questionnaire also discovered at least seven barriers to performing at best environmental practice; lack of public awareness; lack of knowledge about environmental impacts; poor commitment by the top management; lack of legal enforcement by the government and lack of resources; lack of sustainable practices in the organisation's vision and mission and lack of markets for recyclable materials (Ojo, Mbowa, and Akinlabi, 2014). Murugesan (2013) identifies initial capital costs, the challenge of re-engineering processes and businesses' reluctance to change behaviour and culture as barriers to utilising greener technologies. Murugesan (2013) also identifies a lack of alignment between ICT and environmental departments, a lack of management drive and support, a reluctance to learn a new skill, a lack of motivation amongst stakeholders and a fear of job loss or retraining as being the main barriers to implementing green ICT initiatives.

In the business of transport and logistics services providers, there also exist challenges to the adoption of green initiatives. Research carried out on this type of business in Italy in 2011 showed limited access to technology that reduces environmental impact (e.g. vehicles, aerodynamic features), a lack of customer interest or support, negative impact on customer supply chain, a lack of transport/logistics, suppliers' or partners interest, a lack of economic incentives, a lack of clear regulations, a lack of ICT vendors selling specific products supporting green logistics and a lack of standards (including ICT standards). While the business of transport and logistics services providers differs hugely from the business of FHEs, the barriers to implementing greener ICT initiatives are not entirely dissimilar. The barriers listed above could be described as types of; poor stakeholder engagement, cuts in funding, government organisations as poor drivers and greener technology not operating as greenly as anticipated (Isaksson et al., 2011). Even in a country as large and as densely populated as China, as recently as 2009 green ICT was considered an emerging concept. This lack of awareness of the benefits of

green ICT by some CEOs, managers and employees resulted in disinterest from the Chinese in cooperating with their government on environmentally sustainable issues. In addition, the research showed that managers were often driven by short-term and immediate economic results that are not always seen when implementing greener ICT initiatives (Peng, 2011). Where UK FTSE 100 companies are concerned Okereke (2007) proposes three main barriers: lack of a strong policy, uncertainty of government actions and uncertainty in the market place. Subramamiam et al. (2015) add that changes to regulation on carbon management have become politically controversial and therefore a barrier, as well as continuing changes to technological developments themselves. Their research also showed that organisations' overall carbon management plan is positively associated with the existence of a formal carbon strategy, senior management involvement, resource availability (personnel and funds) and energy sector membership. A lack of any of the aforementioned may therefore be considered a barrier. Liu (2012) summarised barriers to carbon management in his study of Chinese industrial organisations. These barriers are divided into four categories of barriers; structural, regulatory, cultural and contextual; and overlap in part with the barriers identified in this research, namely: poor stakeholder engagement, lacking managers, government organisations as poor/weak drivers and green ICT not being as green as anticipated.

This can present significant barriers and resistance to implementing more sustainable ICT systems. As FHE's are large organisations, populated by thousands of people carrying out various tasks, the public sector faces the same barriers. A study carried out by Allman, Fleming and Wallace in 2004 identified twenty separate barriers to sustainability in English and Welsh local authorities in addressing climate change. This list can be summarised down to five as: lack of awareness of sustainability in general; poor stakeholder engagement; lacking managers; lack of sufficient funding; and government organisations as drivers (Allman, Fleming, Wallace, 2004.)

To summarise, research shows that managers across the FHE, business and government sectors lack an understanding of what kind of initiatives can be part of the sustainability performance and furthermore there is a lack of a common overall view about the whole spectrum of drivers and barriers that are relevant to their companies and industries (Berns et al., 2009). While there is evidence to support the argument that barriers to sustainability in the sector exists, specifically to barriers to implementation of greener ICT initiatives, there is an abundance of information

available, provided by a number of national and international organisations, pertaining to the environmental best practice of FHE institutions. An account of those organisations and how they operate is summarised in the following section, Section 2.11.6.

2.11.6 Barriers to Sustainable ICT in FHE Institutions.

Specific to this research, in 2015, similar research into barriers to implementation of green ICT at higher education institutions in India was conducted (Suryawanshi and Narkhedeb, 2015). That research identified ten individual barriers, with lack of motivation and rationale for adopting green polices amongst the implementers being identified as the true barriers i.e. poor stakeholder engagement. The full list of barriers identified included: a lack of adequate funding and support from top management; a lack of participation from necessary students/staff/faculties; environmentally unconcerned institutional cultural; a lack of awareness of green ICT; a lack of education or training from institutes; ICTs environmental impacts not being considered significant; a lack of motivation amongst faculty/staff/student of institutes; a lack of strict government regulation; a lack of good procurement practice at educational institutions and inadequate research and development activities.

In 2016, Mazhar conducted research into carbon management policies' in the UK higher education sector and found that barriers included; a lack of time and resources; complex buildings stock; estate development and business growth; lack of capital funding; conflicts to core business and an overall lack of leadership by senior management underpinned by lack of strong policies.

This is further supported by research carried out in 2015 by a combination of FHE sector support organisations. This research also found that a lack of adequate funding delivering sustainability, followed by a lack of human resources, lack of senior management commitment and lack of student engagement, were the main barriers to a more sustainable campus (EAUC et al., 2015c). Research that examined sustainability programmes in Australian institutions also found that poor leadership, change management, workloads, inadequate funding, staffing and resourcing were all identified as problems affecting sustainability programs (Butt, 2014). Even in Swedish universities, a lack of time, resources and organisational structure were identified as being key barriers to a more sustainable performance and Altan (2010) added that the growth of the HE sector, is in itself a huge barrier as institutions struggle to monitor and measure and then reduce overall energy

consumption, let alone ICT energy consumption. A study carried out in 2010 in the U.S. concluded that there are barriers to making U.S. universities' ICT systems greener. CIOs cited lack of funding for ICT and for greener ICT in particular despite understanding that it is not only good for their green credentials but also for their finances. Institutional leadership was also identified as a barrier. A tenth of CIOs surveyed in the same research stated that they were unaware of what their institution's environmental and sustainable initiatives were and therefore could not understand how their ICT systems could be operated more sustainably. Another barrier identified was lack of baseline data relating to energy use of their ICT systems. The absence of metrics regarding their institution's ICT systems made it impossible to monitor and therefore reduce ICT-related energy use (Sheehan and Smith, 2010). In short, there is a multitude of barriers that prevent institutions, of education, business and government from implementing greener ICT technologies. Collectively, they can be summarised into poor or disjointed stakeholder engagement; lacking managers; institutional culture; government organisations as drivers; performance of green technology; cuts in funding and actions of budget-holders and decision-makers and being part of a purchasing framework.

2.11.7 Poor or Disjointed Stakeholder Engagement.

A stakeholder in an organisation is considered "any group or individual who can affect or is affected by the achievement of the organisation's objective" (Freeman, 1984 via Andriof, et al., 2002; Doherty et al., 2009). It is a key aspect of Corporate Social Responsibility (CSR) (Doherty et al., 2009) and is a tool used by private and public sector organisations when wanting to develop understanding, improve community participation and form agreements to solutions on issues of concern that involved others (Baker, 2014).The benefits of stakeholder engagement are numerous (Future 500, 2013). Apart from helping bring about systemic change towards sustainable development that benefits those involved, particularly local and established communities, it helps smaller organisations compete in an increasing competitive marketplace (Burlingham, 2005). It follows then that disjointed stakeholder engagement can be considered the disjointment of that group or individual from the organisation in question (Goyder, 2000). Such dis-jointment or separation of objectives can be caused by several factors (Burlingham, 2005) and lacking managers is one (Ellis, C.E., 2005).

2.11.8 Lacking Managers

The term “lacking manager” could be considered an overly-broad adjective and in research should ideally be avoided (Morad, 2013). It may also be seen as objective and not very descriptive. Managers typically require a broad skillset and knowledge base of the sector they work in to be effective (Ellis, 2005), so describing a manager as lacking requires further explanation and clarification. Examining how and why university managers are lacking may undercover a series of sector-plagued problems (Özkanli and White, 2009; Knudstrup 1991; Appendix II), may highlight individual institutional problems (Appendix I) or may highlight shortcomings in managers’ abilities (Dechant, 1990, pp.40-49). Either way the term “lacking” encompasses a range of problematic issues that may be considered a barrier to participation in a sustainable ICT project. Cuts in funding is one of those issues. It may also include a list of lacking characteristics; poor knowledge and disinterest of either in-house or outside green ICT projects; being negatively influenced by institutional politics and being under-resourced in terms of funding for new kit, support staff and training.

It is also possible that staff are adequately funded, available and willing to participate in a sustainable ICT project, but are not knowledgeable on the subject of sustainability or of green ICT in particular. As a result they may be less inclined to become involved (Heemanshu, 2011) as they feel uncomfortable working outside of the remit of their role at the university. However, this may be overcome with adequate funding for training. It may also be that staff are knowledgeable of sustainable issues and are willing to participate, but are already overburdened with primary responsibilities and cannot afford to spend time on another project, green ICT or otherwise (Guardian Work Blog, 2013).

2.11.9 Institutional Culture.

The culture of an institution is typically determined by its founding religious order (Turchioe, 2010), subjects taught (Goldsmiths, 2016a) or collaboration with commercial businesses (Jones and Clulow, 2012). For example some colleges’ teachings are focused around art and design (Guardian, 2014) while others are more focused around business and enterprise (UCD, 2017). Regardless of an institution’s founding culture, it is universally agreed that cultures are continually evolving and adapting to be more inclusive of other nationalities, partnering with businesses and overseas universities and to becoming more technology based (Bokoer, 2012;Jump,

2014). These changes are as much a means of survival as they are a move towards modernity. In today's university, culture could be underpinned by the actions of senior management. If senior management does not support an initiative this may be seen as institutional culture being a form of stakeholder disengagement and therefore a barrier.

2.11.10 Government Organisations as Drivers.

As the UK government in the form of the DECC sets targets for reduction in CO_2 emissions to be reached by 2020, it follows that the DECC and similar organisations become drivers for institutions aiming to reach those targets. In 2010, the then UK prime minister, David Cameron, announced that his coalition government would be "the greenest government ever" (Randerson, 2010) and encouraged any organisation that supported a sustainable economy (Carbon Trust 2016;GOV.UK, 2014a). However, Cameron's administration failed to create as great a carbon reduction impact on the sector as hoped. CO_2 emission from the higher education sector increased by 4% in the 5 year period from 2007 to 2012, leading to an open letter being sent to the then University and Science minister, David Willetts (People and Planet, 2012). Sent in March of 2012 and signed by nineteen signatories from a mixture of UK environmental organisations, the letter asked the minister to give greater consideration to increasing investment in carbon reduction and renewable energy for the sector. It also asked the government to ensure graduates acquired the necessary skills to support a greener economy and to the setting up of a new commission involving key stakeholders in developing the pathway to a sustainable higher education sector (People and Planet, 2012). Delays in other green initiatives have shown the government to be less in the driving seat and more in the slow lane when it comes to a speedier greener government (Nichols, 2011;European Voice, 2014). More recently with the "scrapping" of the DECC and its deployment to the Business, Energy and Industrial Strategy Department (GOV.UK, 2016), government organisation as weak drivers is becoming an even greater barriers.

2.11.11 Performance of Green Technology.

The performance of green technology typically refers to its lower energy requirement, has proven to work well in several instances and is a guaranteed way of saving money and reducing carbon emissions (Hasan and Meloche, 2013).

However, where energy savings cannot be quantified or are piecemeal at best, then under-performance of green technology is considered a barrier (Foster, 2011). Also, barriers such as difficulty in

measuring the environmental compliance and therefore the true environmental footprint of a greener piece of technology undermines any positive sustainable impact that the performance of greener ICT may have created (WestLB, 2008).

2.11.12 Cuts in Funding.

Cuts in funding to higher education institutions are a typical governmental response to the need to save money during recessionary times (Kiley, 2011; Oliff et al., 2013). However, such austere measures are well documented as being more costly in the longer term with little if any immediate benefits (Democracy Now, 2013; Chung, 2012). Managers may simply be lacking financing for equipment (Appendix I) or funding for salaries and assistance (Plumer, 2013; Bowcott, 2013). Whether affected by the 2009 UK government cuts in funding to Education and Research (Morgan, 2009), the follow-on HEFCE cuts of 2011 (Morgan, 2011) or the March 2014 UK government budget cuts (Morgan, 2014), universities and colleges are likely to have suffered a deterioration of quality of management of one form or another as a result of diminished funds (Malik, 2013). Similar findings were discovered when research that examined barriers to energy efficiency in Canadian universities' found that "access to capital" was deemed as the largest barrier to energy efficiency (Maiorano and Savan, 2013). While the outcomes of that research mainly focussed on Canadian institutions reluctance to access green revolving funds, the principle barrier of "no funding to be greener" still applies.

2.11.13 Actions of Budget-Holders and Decision-Makers/Being Part of a Purchasing Framework.

Budget-holders' and decision makers primary responsibility is to ensure that all purchases made on behalf of the college are fit for purpose and affordable (Quayle and Quayle 2000). Purchasing frameworks make the procurement of those purchases easy, ethical and affordable for its frameworks members. They are typically a not-for-profit, professional buying organisation and exists to generate savings and better value for its members through the collaborative procurement of goods and services (LUPC, 2013). If a procurement officer is unable

to make a sustainable purchase because they lack sufficient information, this could be considered a barrier under the description of being of lacking manager (Hogan, 2011a).

2.12 Sustainability Organisations for the Sector.

In 2017, three national and four international organisations existed, with the remit of assisting universities and colleges to operate more sustainably (ISCN, 2015). Some offer guidance in the form of participation in league tables (People and Planet 2016), some provide benchmarking tools to assess measure and monitor improvements (Green Impact, 2016a) others are more holistic and strategic and include environmental and social improvements (EAUC, 2017). While there is much overlap and partnership between the organisations and programmes, there is also a clear distinction in what each have to offer. To gain a better understanding of the different types of environmental sustainable support that exist for the FHE sector, the following organisations are featured.

2.12.1 International Organisations.

2.12.1.1 ACTS.

Australasian campuses are supported by the Australasian Campuses Toward Sustainability organisation (ACTS). The ACTS organisation is a sister organisation of the UK's EAUC, with both institutions working closely to share examples of best practice and reward institutions whose environmental and sustainable performance stands out from their counterparts. ACTS aims to inspire, promote and support change towards best practice sustainability within the operations, curriculum and research of the Australasian tertiary education sector. ACTS is unique in its offering of scholarships but overlaps with the EAUC in its organisation of the Australasian Green Gown Awards (ACTS, 2015a; ACTS, 2015b). While similar in many ways to the EAUC, the ACTS website however does not have a separate section on green ICT.

2.12.1.2 AASHE.

The sustainable performance of American colleges and university campuses is monitored and supported by the American Association for Sustainable Higher Education (AASHE). AASHE's mission is to empower higher education institutions to lead the transformation to sustainability. Similarly to the UK's EAUC, Sustainability Exchange and Australia's ACTS organisation, AASHE provides its members with resources, professional development and various networks of support, thus enabling them to operate as sustainably as possible. It also works toward transforming the American educational practices, ensuring that all students acquire the knowledge and skills to meet current sustainability challenges. Similarly to People and Planet's Green League Tables and the EAUC's LiFE programmes, AASHE examines reports on the performance of higher education institutions through its Sustainability Tracking, Assessment, and Rating System (AASHE, 2017; STARS, 2015). Similarly to the ACTS website, AASHE's website does not have a separate section on green ICT but instead offers advice and information on how to reduce overall institutional energy use.

2.12.2 In The UK and Ireland.

2.12.2.1 The Environmental Association of Universities and Colleges.

The Environmental Association of Universities and Colleges (EAUC) was formed in 1997 to address the task of helping universities and colleges to improve their environmental performance. Members pay an annual fee based on the population of their institution and in return are allowed access to an abundance of resources to facilitate the sustainable, ethical and efficient operations of their campus. The EAUC works with its partners to ensure that sustainability is at the core of further and higher education operations and learning. (EAUC, 2015a).The EAUC also organise a sustainability performance ranking system for universities and colleges. Formerly named the Universities that Count (UtC) programme but later rebranded as the Learning in Future Environments (LiFE) Index, it is essentially a framework to help FHE institutions measure, monitor and improve their sustainable and social performance (EAUC, 2015b). The EAUC also organise an annual event called the Green Gown Awards that recognises the outstanding environmental performance of UK FHEs under various categories. (EAUC, 2016a). In previous years the awards

have included a category for green ICT. Institutions submitted applications explaining how they reduced running costs and carbon emissions by implementing a green or series of green ICT initiatives (see section 2.15.1 for more details).

2.12.2.2 People and Planet.

Founded in 1969 and originally known as “Third World First”, People and Planet is based in the UK and essentially consists of groups of people at universities and colleges who campaign to protect the environment, end world poverty and defend human rights. People and Planet engage in sustainable projects and actively campaign on global issues by having debates, organising media stunts and hosting demonstrations and boycotts. They also organise a league table of university sustainable performance. Named the Green League Table, it takes a multilayered approach to environmental performance by examining a university’s commitment to systemic improvement in the form of policies, tenders and agreements and combining it with corresponding quantitative data – in the form of kWh of energy and tonnes of CO_2 emissions. In 2016, over 140 universities and colleges in the UK submitted data in order to be ranked on the People and Planet Green League Table and their results were published in November 2016 in the *Guardian* newspaper and online (People and Planet, 2016). While their league tables do not have a separate green ICT section, several of their campaigns are centred on reduced carbon emissions via reduced energy use, which would include ICT.

2.12.2.3 Green-Campus Ireland.

The Green-Campus Programme (GCP) is a programme run by An Taisce, an Irish government organisation tasked with preserving and protecting Ireland's natural and built heritage (An Taisce, 2017). The GCP has been in operation in Ireland since 2007 and awards green campus status to FHE institutions that successfully complete its seven steps of accreditation: establishing a Green-Campus committee, incorporating student and staff representatives, undertaking an environmental review, implementing an action plan, monitoring and evaluating actions carried out, linking the programme to curriculum work, informing and involving the campus and wider community and developing a green charter (Green-Campus Ireland, 2016). In 2017, over twenty Irish campuses were formally registered on the programme, with nine awarded the Green Flag including one hospital site. As the programme is

continuous, institutions are required to submit annual progress reports and are reassessed every three years. All Irish universities and more than half of institutes of technology are involved in the GCP to some extent with many awarded Green-Campus status (Trinity College Dublin, 2014). An Taisce therefore essentially supports FHEs in Ireland that may be keen to implement sustainable ICT initiatives in an effort to reduce running costs and save on carbon emissions.

2.13 International Tools for Measurement of Environmental Performance.

2.13.1 STARS.

The AASHE organisation runs the Sustainability Tracking, Assessment and Rating System (STARS). It is a transparent, self-reporting framework for American colleges and universities to measure their sustainability performance. The frameworks consist of an online tool that STARS participants can gain credits towards after submitting data relating to environmental initiatives such as energy sources, paper use etc. These credits are tabulated to assess their overall performance and can earn points toward a STARS Bronze, Silver, Gold or Platinum rating. In many respects the STARS online reporting tool is similar to both the EAUC's LiFE and Green Impact on line assessment tools, and as they all help institutions measure and grade their campus's sustainability performance (STARS, 2016). Inputting data pertaining to improvements in ICT energy use is featured but only in combination with other energy savings data, thereby giving an overall total for energy use reduction per institution.

2.13.2 The University of Indonesia Green Metric World University Ranking.

The Green University Index of Indonesia started in 2010 and is open to institutes across the globe. The awards are based on a philosophy that encompasses the three Es: Environment, Economics and Equity. Universities' environmental performance are scored against a list of criteria that have been selected by their importance by universities concerned with sustainability. These include the size of the university and its zoning profile; urban, suburban or rural. A category on energy consumption is included as is a section on transport, water usage, waste management, etc. The scoring for each section is numeric and responses to the

questionnaires are on a scale of 1–5. Each of the criteria is categorised and results are processed to give a final calculation (UI, 2015). The GUI does not however request data pertaining specifically to ICT energy use or any savings made through implementation of more sustainable technologies.

2.14 Tools for Measurement of Environmental Performances in UK.

That which cannot be monitored cannot be measured, and similarly, demonstrating improvements is impossible if firstly baselining environmental parameters has not occurred. There are several programmes that measure the environmental performance and progress of institutions and each programme overlaps with the other as regards the criteria institutions' performances are measured against. The four principal programmes in the UK that measure sustainable performance of universities and colleges are Green Impact, the LiFE Index, People and Planet's Green League Table and AUDE's Green Score Card. (Green Impact, 2016a; EAUC, 2015b; People and Planet, 2016; AUDE, 2016). In the U.S. it's the STARS programme (STARS, 2015) and globally it's the University of Indonesia's Green University Index (GUI) (UI, 2015). However, LiFE participants' individual results remain confidential while the scores of participants in the Green League Table and GUI performance are made public. After an extensive review, the researcher found evidence of only two monitoring tools – namely Green Impact's workbook and AUDE's green score card – requesting evidence of the implementation of sustainable ICT initiatives. The others only requested information pertaining to overall energy use.

2.14.1 Green Impact.

Green Impact is a national programme run by the National Union of Students (the NUS) and provides participating institutions with a bespoke workbook of criteria, giving a structured framework for taking actions that contribute to reducing institutions overall environmental footprint. Participating institutions are usually made up of teams consisting of departmental staff who take responsibility for implementing environmental initiatives in their departments. Initiatives can be as simple as hanging signage with a green reminder in high traffic areas, or much larger, such as representation on an environmental committee or providing evidence of energy reduction. The programme typically runs throughout the academic year

and participants are rewarded with a Gold, Silver or Bronze award at the year's end (Green Impact, 2016a). Students are encouraged to become Green Impact Project Assistants (GIPAS) and receive an IEMA accredited certificate on completion of assistant and auditor training (Green Impact, 2016b). The Green Impact workbook even has a section on it pertaining to green ICT. It requests that users provide evidence of any form of a sustainable initiative implemented successfully. Placing signs on PCs or near MFDs reminding users to switch off when not in use is advised and points are offered to improve overall energy scores.

2.14.2 LiFE.

LiFE is a programme that provides HEIs in the UK with the tools to assess their overall performance in and approach to environmental and social issues. Commencing in 2005 as a pilot project, then called Universities that Count (UtC), its aim was to provide institutions with a benchmark value of their overall environmental performance. This value was then to be improved on year on year. While this is still primarily the programme's aim, it has more recently expanded to include the social and corporate responsibility (CSR) of its participants. The methodology of assessing the performance of participants in LiFE involves participants submitting data relating to their energy use, water consumption, staff and student travel etc. Results are collated, improvements or declines in performance are recorded, and final results are sent to institutions and the wider sector in the form of a LiFE annual report (EAUC, 2015b).

2.14.3 The Green League Tables.

The Green League is the only national league table showing the environmental performance of Britain's universities. Started in 2007, and organised by People and Planet, the Green League Table ranks universities' performance in eleven categories. Those categories include environmental policies, staffing and auditing, ethical investment, carbon management, sustainable food and Fairtrade, student and staff engagement, energy, waste and water use. People and Planet organisation requests basic environmental data and information from almost every university and

college the UK. The information requested is obtainable under the Freedom of Information Act 2000, but the People and Planet organisation request it in an official capacity along with additional environmental information. Universities and colleges typically comply with this request, as it is in their best interest to do so. Institutions that subsequently fail the grade typically do so because they have not submitted relevant environmental data and information relating to their institution. People and Planet use a team of interns to assess the information submitted by institutions and then publishes the annual league table in the UK's Guardian newspaper. Green ICT is not examined as a separate category but savings made from successful implementation of green ICT can be added to the carbon reduction section.

2.14.4 The AUDE Green Score Card.

The Association of University Directors of Estates (AUDE) Green Scorecard was developed in 2016 in conjunction with the Environmental Association for Universities and Colleges (EAUC). The scorecard is essentially an online reporting tool that education institutions can use to measure their environmental efforts, set targets and benchmark against each other. It focuses on areas such as energy, transport, water, waste, biodiversity and landscape (AUDE, 2016). The scorecard was created after the 2015 Brite Green University Sector Carbon Progress Report was highly critical of English higher education institutions. The report found that institutions had fallen further behind in their carbon reduction objectives in relation to the 2020 sector target set out by the Higher Education Funding Council for England. Since the Green Score Card's launch in 2016 more than 120 institutions have signed up to participate (White, 2016). The scorecard's interactive design allows users to compare their institution's performance to that of others on line. In doing so it reiterates to university managers the role each institution plays in improving the sector's overall performance (Elmes, 2016). By 2017, it was reported that 82% of institutions were actively using the Green Scorecard tool and the sustainable performance of the sector was improving (Pick, 2017). Similarly to other monitoring tools, the AUDE scorecard does not request data pertaining solely to ICT energy use or any savings made via the implementation of greener technologies. Instead it requests data regarding general energy awareness, change in scope 1 and 2 emissions, any reduction from 2005 baseline and overall carbon reduction targets. It also asks about an institution's absolute change in building energy consumption, which includes ICT energy use.

2.15 Recognition of Environmental Performance.

2.15.1 The EAUC and ACTS Green Gown Awards.

The EAUC host the Green Gown Awards each year. They are one of the most the most widely recognised awards shows in the sector. Each year the list of categories expands to include a new area of campus sustainability. In 2016 the total number of categories was sixteen with a total of 115 finalist representing sixty-three institutions (EAUC,2016a). Businesses are invited to sponsor the awards but must have a sustainable aspect to them or must be a provider of sustainable goods or services to the FHE sector. Judges of the awards are EAUC members in senior positions who have an excellent understanding of and experience in the category they are judging.

Anglia Ruskin was shortlisted in 2015 for a Green Gown Award for Best Sustainable Professional and Goldsmiths was shortlisted in the same category. Goldsmiths was also commended for Best Newcomer in 2014 and had two other entries shortlisted in 2015 and again in 2016. Addressing the importance of green ICT in the sector, the Green Gown Awards had a green ICT category from 2009 to 2012, which was won by four different institutions. Each winner had demonstrated how by investing in greener, more energy efficient technologies they were able to make considerable cost and carbon savings. For example, the 2009 Green ICT GGA winner was the University of Liverpool. They won for their PC PowerDown project. They installed software that automatically power downed the thousands of PCs in their PC labs saving the institution £60,000 in one year (Green Gown Awards, 2010). In 2011, the University of Herefordshire refurbished and restructured their data centre making it more energy-efficient all round, resulting in a power utilisation efficiency (PUE) improvement of an estimated 0.98 and saving £38,000 in one year. In fact they were acknowledged as being the first European university to achieve accreditation to the EU Code of Conduct (Green Gown Awards, 2011).

In 2012, De Montfort University won for their *GreenView - Seeing Energy Differently* project. This project allowed staff and students at De Montfort to see the live electrical consumption of their buildings on their smartphones, using a web-based app. The app used animated endangered species to show the live electrical data of the building. This unique way of engaging with staff and students reminded them of the wider environmental impact of their energy use. It improved peoples understanding of the use of live data dashboards and its methodology has even become part of a wider SmartSpaces project that allows public authorities across

Europe to exploit the benefits of ICT, thereby managing their buildings' energy use better (Green Gown Awards, 2012).

However, since 2012 green ICT has not been included as a separate category in the Green Gown Awards. This is likely to be because by 2013 JISC's Greener ICT programme had ended and it was predominantly their projects that were encouraged to apply for the award. Institutions currently tend to submit projects that involve the reduction of overall energy use, where ICT is just part of a wider programme that tackles energy waste from lighting, heating and excess electrical equipment being used (Green Gown Awards, 2017).

2.16 Summary of Chapter 2.

Universities and colleges are not only institutions of historical and educational significance, they are crucial to the progression of the economy. They are a unique workplace where leaders of the future learn how to think critically, independently and innovatively. They are places of engagement, of interdisciplinary research and where the gathering of new empirical data occurs. Where environmental sustainability is the focus of research, they become "living laboratories". However, their survival is increasingly threatened. Funding to the FHE sector has been cut and like any business, they are having to create new streams of revenue to ensure their survival. The practice of "sweating their assets" has become the norm.

Estates management are employing cost-saving ICT initiatives that are proving not only popular, but essential. Utilising greener technologies to not only save on running costs but to engage with stakeholders in environmental behavioural change is increasingly common place. Improvements to environmental performance via the use of these interconnected ICT systems that report real-time data are being regarded within the sector as the way of the future and are being made possible through the support of sector support organisations such as the EAUC, ACTS and AASHE and the programmes they run.

However, identifying and overcoming any barriers to the implementation of such ICT systems requires a significant amount of research. Such research must utilises the correct research methodologies over the course of the entire research period. The next chapter, Chapter 3, does exactly that. It offers a detailed discussion of the research paradigms, methodologies and methods chosen for this body of research as well as offering an explanation as to why they were chosen.

Chapter 3 Methodology

3.0 Introduction.

This chapter outlines the research paradigms, the methodologies and the methods used in gathering evidence to answer the research question and its sub-questions. It explains how the research evolved over three consecutive and interlinked stages and, using references to literature, offers insights into why the types of research methods chosen were appropriate. This chapter also offers a justification for the use of each of the research paradigms, methodologies and methods used throughout the research. A short review of the research aims is included to serve as a reminder to the reader why the research strategy chosen was suitable. It also includes a section on professional reflection and its association with action research. This chapter discusses the importance of valid and reliable data, as well as the ethical considerations made throughout the research.

3.1 Forms of Available Data.

The data on which this research is founded became available in the form of surveys, questionnaires, correspondence and interviews. The data are therefore anti-positivistic and qualitative, but also positivistic and quantitative in parts. Regardless, all data in this research are robust and reliable.

3.2 Research Aims and Objectives.

This research aims at improving the use of ICT as an effective tool for a sustainable future in universities and colleges. Its associated objectives are (i) to identify the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives and to (ii) develop an ICT solution to overcome those barriers.

The core aim of this research is to reduce ICT energy waste and associated CO_2 emissions and thereby save FHE institutions money in unnecessary ICT running costs. In order to identify and evaluate possible barriers and limiting factors, this research was divided into three stages (Stage 1, 2 and 3) with each stage incorporating a different combination of research paradigms, methodologies and methods of data collection.

This was done in order to simplify and clarify what is essentially a long and multifaceted research project with each stage contributing in a unique way to answering the research question, sub-questions and ultimately achieving the research's overarching aims and objectives.

The research question asked:

1. What are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives?

The sub-questions asked:

2. What are the key implications of those barriers? and
3. How can a sustainable ICT solution alleviate those barriers?

3.3 The Importance of Professional Reflection.

Professional reflection occurs when practitioners mindfully contemplate the actions and outcomes of their work, over a number of years. Reflection often occurs when practitioners are challenged, or are at a stalemate in their professional lives where ethical or moral dilemmas have been presented. It typically occurs where the same practitioners feel a change to the norm is required (Laabs, 2011). Schön who is considered an authority on reflective practice, hoped that reflection would encourage practitioners to "*surface and criticise the tacit understandings that have grown up around the repetitive experiences of a specialised practice*" (Schön,1983, p.61) and when accompanied by action research, effect change that results in improvements to the sector. Often seen as a "luxury one cannot afford", reflection has become essential to clear and careful thinking by professionals regarding their roles and what's expected of them (Thompson and Thompson, 2008, p.8)

Reflection is central to this research. It is particularly central to action research, as it is often the source of effecting change that is delivered through that action research. Without reflection there can be no transcending to a high level of thinking, which is central to a successful professional doctorate (Wisker et al., (2003) and (2003b) via Trafford and Leshem, 2012, p.146). Reflection is more than a sequence of ideas; it involves consequence – "*a consecutive ordering in such a way as each determines the next to determine its proper outcome*". In short, it's the ability to "join the dots" and therefore predict what is likely to occur again. It is essentially learning from

experience, (Dewey, 1933). It was while reflecting on the poor levels of participation in the Scotland and UK SUSTE-TECH projects that it occurred to the researcher that a systemic and underlying problem existed within the sector that was ultimately sabotaging any attempts by staff to operate more sustainably. Originally, reflections led to the consideration that cuts in funding to the sector were solely responsible for poor participation and any related loss in cost and carbon savings. However, after an iterative process of reflection the realisation that other barriers and inhibiting factors may have had an equally influencing effect was arrived at. After some initial research into possible barriers and limiting factors, the researcher could not find another body of research that addressed this gap. It was at this point that the gap in knowledge and problem within the sector was identified.

3.3.1 Critical Reflection.

Another layer to professional reflection is critical reflection. Critical reflection occurs when a critical approach is used in research, i.e. when cultural changes influence practice. Critical reflection can be thought of as a way of understanding and engaging with the interconnections between experiences, emotions, meanings and social context (Gardner, 2014). This is essentially what the researcher experienced while working as the SUSTE-TECH project manager. It is important not to confuse the term “critical” with the practice of casting judgement or criticism on others. Gardner (2014) argues that critical reflection lends itself to creating an atmosphere that is accepting and non-judgemental where participants feel comfortable exploring their feelings and thoughts about their practice, thereby enabling them to ask difficult and probing questions.
It is only under this type of non-judgemental and relaxed environment that innovative solutions to sector problems can be found and ultimately research questions be truthfully answered (Gardner, 2014). Where this research is concerned, the researcher’s background is in environmental sustainability, and much of her research is being conducted throughout her career as she experiences changes in the management of the sector and of the associated behaviours of its stakeholders (Williams, 2003, p.1).

Critical reflection is therefore both a theory and a process that involves a deeper look at the premise on which thinking, action and emotions are based. When connections between these assumptions are made, they form the basis for social and cultural change (Fook and Gardner, 2007, p.14). In addition, reflection can occur

at any stage of the research and indeed can and should occur at more than one stage. Much like action research, reflection should be iterative, occurring when the practitioner first reflects on the theory-practice gap that is the precursor to establishing the research question (Fulton et al., 2013) and again throughout the course of the action research.

Frame (2013) cites Cohen (2000) stating that the three components to reflective practice are:

1. Descriptive – what exactly is the problem/issue?
2. How does it currently operate/work?
3. How well does it operate/ work/ what is not working?

Fulton et al. (2013) go further and state that it involves self-awareness, understanding the motives and aims of others. It also involves critical analysis and a willingness to be flexible in order to see situations differently as opposed to just contemplating what should have been done differently. These “tools of reflection” were used when forming the research questions for this study and throughout the research journey. Finally, as practitioners should ideally obtain supporting material from elsewhere to aid the process of critical reflection, the researcher read several papers on the subject of sustainability in FHEs.

It included the professional experience of others, recent literature on the subject, published peer-reviewed papers and advice from other sector experts (Moon, 2006).

3.4 Stages of the Research: The Stages 1–3.

3.4.1 The Stage 1 Gathering the Preliminary Data.

The Stage 1 of this research involved gathering the preliminary data by adopting an anti-positivist research paradigm, an inductive research methodology and using qualitative research methods. Each aspect of The Stage 1 research strategy played a role in gathering data that would ultimately lead to the realisation of the research question and sub-questions, plus lead to the belief that a gap in knowledge existed and that further research into the phenomenon was required to bridge that gap. In keeping with the paradigm, methodology and methods, these data were gathered during the researcher’s time as a green ICT project manager with the EAUC from 2010–2012 and consist of data from case studies, e-mails, minutes of meetings,

preliminary surveys, committee update reports and final reports, all stemming from management of the Scotland ICT Carbon and Energy Management project and the UK SUSTE-TECH project.

3.4.2 The Stage 1 Research Paradigm.

The Stage 1 paradigm is anti-positivistic. New knowledge was gained on the subject through personal experience rather than acquiring it from an outside source (Cohen, Mannion, and Morrison, 2000; Dash, 2012 via Cohen, Mannion, and Morrison, 2000). This personal experience relates to FHEs' participation in the Scotland ICT Carbon and Energy Management project and the UK SUSTE-TECH project and the new knowledge relates to discovering possible barriers and limiting factors inhibiting the realisation of the potential benefits of sustainable ICT initiatives within the FHE sector. This research is also underpinned by the belief in the value of meaning as the researcher decided that this inability was a result of something more systemic that required further investigation (Lilly, 2012). As the researcher was party to what was being observed and attempted to understand what was happening, this anti-positivistic research allowed for the construction of phenomena from the data using small samples, researched in depth or over a period of time (Gray, 2004 via Bull, 2008).

3.4.3 The Stage 1 Research Methodology.

An inductive methodology was adopted for The Stage 1 of this research as a pattern of events and behaviours within the sector was observed after intermittent reflection on the ongoing progress and ultimate outcomes of the Scotland and UK SUSTE-TECH case studies. Through this observation, a phenomenon was inferred that formed the basis of the research question and its sub-questions (Burney, 2008). The very nature of how the research evolved, particularly in its earlier stage, lent itself to being inductive (Aron, 2011).

The preliminary data collection and subsequent data analysis were followed by the development of a phenomenon (Saunders, Lewis and Thornhill, 2003). As inductive methodologies tend to look for patterns and themes associated with real observations (Ritchie and Lewis, 2003), this is precisely what occurred in The Stage 1 of this research. This inductive approach, often called a 'bottom-up' approach, worked from a specific observation to a broader generalisation and in this instance

lead to the development of the theory from which the research questions stemmed (Saunders, Lewis and Thornhill, 2009).

3.4.4 The Stage 1 Methods of Research.

The Stage 1 research methods are mainly qualitative as data were non-numerical (Robson, 2011) and included documentation and communications in the form of e-mails, committee updates and phone calls, all forming the basis of case studies (Berg, 2009). Qualitative research was chosen as it facilitated in-depth analysis and evaluation of small samples as they naturally occur (Payne and Payne, 2004). An investigation of the 'social world' of FHE managers through learning about their experiences, perspectives and circumstances occurred (Ritchie and Lewis, 2003) which ultimately led to the decision to conduct further investigation in order to gain new knowledge on possible barriers.

The Stage 1 qualitative data were presented in the form of feedback from FHE managers explaining why they could not participate in the SUSTE-TECH project or where Scottish institutions were concerned, apologising for their inability to following through with submitting final data relating to their ICT energy savings. These qualitative data, according to Hoxley (2004) were subjective in nature as the phenomenon emerged from the data in the form of barriers and limiting factors to institutions participating in sustainable ICT projects. These barriers and limiting factors also becomes apparent upon reflection on the results of preliminary surveys, conducted during the researcher's time as a green ICT project manager, and on feedback from Scotland and UK SUSTE-TECH project participants. However, quantitative data also emerged as part of the wider preliminary dataset and were produced as part of the results of the preliminary surveys that were conducted throughout the course of the SUSTE-TECH project. These surveys included metrics in the form of percentage response rates to each of the preliminary survey questions.

3.4.5 The Stage 1 Types of Research.

Descriptive research, correspondence research and case study research are the three interlinked types (or categories) of research adopted for the collection of preliminary data of The Stage 1 of this research. They were chosen as they were deemed the most suitable when researching and gathering information and data as they contained essential information that indicated the presence of barriers to

sustainability in the FHE sector. Such information and data would ultimately contribute to answering the research question and sub-questions.

3.4.5.1 Descriptive Research

Descriptive research was conducted in The Stage 1 when each of the observations pertaining to possible barriers was recorded in relative detail, which was part of the larger exploratory process. The recordings and observations were made throughout the course of the Scottish and UK SUSTE-TECH projects, thereby establishing what the norm was, (frustration at being unable to implement greener ICT initiatives) and, central to the formation of the research question, a prediction was made as to what might happen again under the same circumstances (Leedy and Ormrod, 2010). Descriptive research proved essential to this investigation in so far as a lack of it would have proven to be a barrier and therefore detrimental to gathering sufficient qualitative data in the form of evidence of possible barrriers. This was particularly important as an improvement in sustainability was what was required (Salzmann, Ionescu-Somers, and Steger, 2005). The Stage 1 descriptive research took the form of outcomes of surveys circulated, e-mails sent and committee update reports where each of the observations made, was recorded (Walliman, 2011). It was through examining the contents of these “descriptive documents” that a set of predicted outcomes, known as the norm, was established (Creswell, 2003, p.14 via Williams, 2007). It was also at this stage that a gap in knowledge was identified, the research questions were conceived and it was decided that further investigation into possible barriers and limiting factors was required.

3.4.5.2 Correspondence Research

Correspondence research is essentially the examination of sources of correspondence between the researchers and/or others participating in the research (Harris, 2002). Where this research is concerned, it occurred between the researcher and a variety of FHE managers in the form of e-mails, mid to end of term reports and committee update reports. These types of correspondence are each a source of reliable primary, and in this investigation, exploratory data (Santiago Canyon College, 2016). To date, a minimal amount of literature exists on the use of correspondence as a primary data collection method in qualitative research but this category of research and its research methods is growing, as the use of electronic

devices to communicate and correspond also increases (Pole and Lampard, 2002). This correspondence research essentially formed the basis of the Scotland and UK SUSTE-TECH case studies and Coley (2008) advises on maintaining good relationships in an effort to obtain additional reliable data (Coley, 2008). Both types of preliminary research previously described descriptive and correspondence research, provided the basis for the third category of research in this investigation: case study research. All three types of research were interlinked and were part of a larger, holistic and all-encompassing view of FHE struggles to reduce carbon emissions and save money by participating in sustainable ICT projects from 2010–2012.

3.4.5.3 Case Studies Research

Case studies are extremely useful and important strategies for conducting social research (Feagin, 1991). They were chosen for this research as they provided the means by which to compare and analyse the outcomes of the UK SUSTE-TECH and Scotland ICT Carbon and Energy Management projects. As case study research has been described as

> "*an enquiry that investigates a contemporary phenomenon within its real-life context especially where the boundaries between the phenomenon and the context are not clearly evident and where multiple sources of evidence are used*" (Yin, 2003, p.16),

it is especially fitting for this research as the phenomenon of possible barriers and limiting factors was not clearly evident, initially, despite multiple sources of evidence supporting its existence (Stake,1995). Almost every social scientific study may be regarded as a case study and as an analysis of social phenomena specific to a time and place (Ragin and Becker, 2005); this is why it is particularly appropriate as a research approach in The Stage 1. Scottish and UK universities and colleges being unable to participate fully in sustainable ICT projects were essentially the social phenomenon occurring from 2010–2012 while the researcher worked as a sustainable ICT project manager for the EAUC. These case studies provided a rich source of data to reflect on to help establish the nature of the issues to be examined in this research.

Another reason for choosing case study research as part of the wider research strategy for this experimental theory was that set procedures comprising of several different combinations of data collection, such as e-mails, telephone calls, reports and results of preliminary surveys were used where the aim was to investigate a phenomenon (Fellows and Liu, 2003). Case studies typically have the characteristic of being a story that draws upon multiple sources of evidence and are based on triangulation of the sources of evidence (Remenyi, 2002). This is very much the case with the UK and Scotland ICT projects as each contain evidence in the form of e-mails, SusteIT Tools and results of mid-term and final reports. Gillham (2000) and Yin (2003) would have grouped the preliminary data into documents, archival records, interviews, detached or direct observations and participant observations and would have regarded each as playing an important part in this case study research. Yin (2009) also argued that case study research is preferred when 'how' or 'why' questions are posed and where the researcher has little or no control over responses. Case study research was therefore selected as it was important to establish the 'how' and 'why' questions posed to FHE managers throughout The Stage 1 of this research. It was their responses that ultimately resulted in the emergence of the research question; what are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives? and its sub-questions; what are the key implications of those barriers? and how can a sustainable ICT solution alleviate those barriers?

Case study research was not only suitable for investigating the 'how and why' questions, but also suitable for developing and further refining it (Voss, Tsikriktsis and Frohlich, 2002). It was also particularly relevant as it pertained to real-world practice and therefore provided a better insight into the process under investigation (Gill and Johnson, 1997). Finally, Mazhar (2016) suggests that, '*in order for an in-depth case study research to provide insights into the phenomenon, it should be representative of a broad range of cases'* (Mazhar, 2016, p.103). The preliminary data, i.e. the Scotland and UK SUSTE-TECH projects, consisted of several smaller case studies, numbering in total nine universities and colleges that provided a broader range of cases from which to examine data. Case study research adopted for this investigation, it has exemplified typical values and provided a general understanding of the phenomenon that is the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives (Gerring, 2007).

3.4.5.4 Survey Research.

It is argued that ‘‘*when something is surveyed, it is ‘viewed comprehensively and in detail’ and the purpose of doing a survey is generally to ‘obtain data for mapping’’* (Denscombe, 2010, p.11). Surveying is a patchwork of various kinds of data collected by different means and processed in alternative ways (Converse, 1987). Where empirical research is concerned, surveys are conducted with the intention of achieving a broad and inclusive coverage about a particular phenomenon (Denscombe, 2010). It was for these reasons that survey research was chosen as a method of research for The Stage 1 of this investigation. Surveys are widely used as part of larger research strategies, particularly in social sciences, and, specific to this investigation, included survey questionnaires. While the definition of a survey has narrowed over the years, it still encompasse basics but key aspects of:

(i) data collection in the field,
(ii) employing a multitude of methods to gather data on the subject matter and

(iii) providing a means of establishing the value or extent of the phenomenon being surveyed by counting or measuring all or some of the information gathered
(Andres, 2012).

Although similar in description, there are differences between surveys and questionnaires and those differences are tabled in Table 3.1.

Table 3.1 Differences between survey and questionnaires.

Surveys	Questionnaires
• Can refer to a patchwork of multiple sources of data. • A process for gathering data that sometimes involves a wide variety of data collection methods that a questionnaire may be part of. • Observing or measuring things that go beyond questions, including physical measurements, metrics, judgements by a researcher and analyses of existing data.	• Refers to a single source of data collection that may be part of a larger investigation. • List of questions for gathering data. • Questions typically pertain to a single topic. . (Fink, 2009; Andres, 2012)

In The Stage 1 of this research three preliminary surveys were conducted as part of the ongoing attempt to understand why participants in the Scotland and UK

SUSTE-TECH projects were failing to participate fully and to gain an overall synopsis of the uptake of sustainable ICT within the sector. These small-scale surveys enabled the gathering of both qualitative and quantitative data pertaining to the demographics and opinion of FHE managers in UK institutions from 2010 to 2012 (Andres, 2012).

The characteristics of the questions were a combination of nominal (observations belonged to types), ordinal (order existed amongst the types such as excellent to very poor) and numerical (values between 0 and 30) in parts, adding an element of descriptive statistics to the research thereby making the data valid and robust (Fink, 1995). As is often the case when conducting survey research, FHE managers were simultaneously the object, the participant and the audience (Igo, 2007). However, this was unavoidable and even necessary as it was the opinion of that target audience in question that was essential to gathering reliable data (Andres, 2012; Fine et al., 2000). Finally the questions would provide further insights into what emerged from the reflection on practice.

The surveys' questions were valid as their target audience was a cross-section of hundreds of FHE managers from across the UK and Ireland. While they included the Scotland and UK SUSTE-TECH participants, they mainly consisted of various FHE subscribers to the EAUC's mailing lists. The surveys were reliable in so far as the survey can be easily reproduced by another organisation at any time and are likely to produce similar results (Andres, 2012, pp.122–123: Fink, 2009, p.41).

The preliminary surveys contained open- and close-ended questions and formed the basis of both qualitative and quantitative data collection for this investigation. It was ensured that both types of question were incorporated into the surveys, making participation in them easy and engaging, while at the same time facilitating unanticipated responses (Fowler, 2014). Many of the close-ended questions offered alternative responses (multiple choice answer options) and this in itself offered an easier method of interpreting the meaning of responses (Schuman and Presser, 1981).

3.4.5.5 Designing the Survey Questionnaire.

"Survey questionnaires are research tools through which people are asked to respond to the same set of questions in a predetermined order" (Gray, 2004, p.187).

The use of verbal data has come to dominate the social sciences and asking questions is widely accepted as a cost-efficient and direct way of gathering valid data pertaining to past experiences and behaviours, private actions and motives, beliefs, values and attitudes (Fink, 2009). In some instances, it is the only way to gather such data (Foddy, 1995). For these reasons it is crucial to establish from the onset of the research who the research's target audience is, how they are to be accessed, how wide the target audience needs to be, what questions need to be asked, how the questions are to be worded and how many questions the questionnaire should contain (Fink, 2009; Fowler, 2014). Each of the preliminary survey questionnaires conducted as part of this investigation factored in each of these potential pitfalls. Had they not been given the consideration required, they would have resulted in invalid and unreliable data. However, this was not the case in this research. Each of the questions in the preliminary surveys was worded clearly and concisely, offered open- and close-ended answers to facilitate unanticipated responses and engaged with enough respondents from a sufficiently wide target audience to obtain a statistically valid response rate. This was primarily due to the use of the online survey questionnaire, SurveyMonkey. SurveyMonkey was used in The Stage 1 of this research, and throughout, as it was considered to be a suitable means of gathering reliable and valid data (SurveyMonkey, 2016; Mazhar, 2016).

On line survey questionnaires are:

i. Are a cost-efficient and direct way of gathering valid data pertaining to past experiences and behaviours, beliefs, values and attitudes (Fink, 2009);

ii. Allow for a group of people to respond to the same set of questions in a predetermined order (Gray, 2004); and

iii. Can be conveniently completed online using a variety of mobile ICT devices (Mazhar, 2016; SurveyMonkey, 2016).

The online survey tool SurveyMonkey, was chosen for this investigation as it:

i. Allowed for respondents to return to completing the survey at their convenience;

ii. Allowed for close-ended questions to be answered with the simple click of a mouse;

iii. Allowed for comment boxes to be included when answering open-ended questions.

iv. Facilitated in the directing of respondents towards follow-on questions so they were not asked to answer questions that did not pertain to them;

v. Made data analysis easy as charts and graphs could be automatically generated; and

vi. Answers from individual respondents could be examined, question by question.

Responses to The Stage 1 preliminary surveys also underpinned and overlapped with what was later recognised as being some of the possible barriers and limiting factors. Upon reflecting on the outcomes of all of The Stage 1 research data, it was at this stage that the existence of a gap in knowledge was realised and the research question was conceived.

3.5 The Stage 2: Answering the Research Question via the Outcomes of the UK and Irish Survey Questionnaires.

The first part of The Stage 2 of this research was designing the questions that were to be included in the main UK and Irish survey questionnaire. The questions needed to collectively and ultimately provide answers the research question and its sub-questions:

1. What are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives? and its sub-questions;

2. What are the key implications of those barriers?

3. How can a sustainable ICT solution alleviate those barriers?

Similarly, to the reasons for the use of an online survey questionnaire in The Stage 1, it was considered to be the most suitable means of gathering reliable and valid data. Again, it was cost-efficient and allowed for a large number of people to conveniently and efficiently respond to the same set of questions in a logical order (Fink, 2009; Gray, 2004).

The same online survey tool, SurveyMonkey, was chosen for a second time in this investigation as it;

(i) Allowed for respondents to complete the survey using a variety of ICT devices and return to completing the survey at their convenience;

(ii) Allowed for close-ended questions to be answered with the simple click of a mouse and for open-ended questions to be answered using comment boxes; and

(iii) Allowed respondent to answer logical follow-on questions so they were not asked to answer questions that did not pertain to their previous responses.

For these larger and considerably more intricate surveys, it allowed for the examination of responses per individual and omission of any responses that came from outside of the geographical locations via simple deletion, so as not to askew the overall results. Finally, SurveyMonkey facilitated the researcher in reaching as wide a target audience as possible through its accessibility via an electronic link circulated via e-mail.

3.5.1 The Stage 2 Survey Questionnaires.

Survey questionnaires were used as they provided data regarding the existence of possible barriers and to what extent they existed. Any patterns of responses to the questions by FHE managers needed to be identified as this would further enrich the research outcomes. There was also a need to establish the backgrounds of each of the survey respondents and the length of time each had worked in their current role and in the sector. Survey questionnaires facilitated this and any additional data gathered via the questionnaires further validated the data. The Stage 2 of this research included open- and close-ended questions that again formed the basis of

both qualitative and quantitative data collection (mixed methods of data collection). Nineteen questions were asked in total, with seven of them being close-ended questions pertaining directly to the presence or absence of each of the barriers. Responses to these seven 'barrier-related questions' would offer a definitive answer to the research question "*what are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives".* Their follow-on close- and open-ended questions would answer the research sub-questions: "*What are the key implications of those barriers?"* and *o*nce these questions were answered the second sub-question *"how can sustainable ICT solutions alleviate those barriers"* could be answered based on those results.

Similarly to Stage 1 of this research, each question had a choice of answer options and while most of the answer options were closed, some were open- and included comment boxes. This proved to be particularly useful as many of the respondents contributed to the research using their own words (Fowler, 2014) and as their confidentiality was guaranteed, they felt comfortable and confident in giving their true opinion. Some of the close-ended questions, which offered alternative responses, were added to offer a logical, follow-on design to the survey which again proved to be an easier method of interpreting the meaning of responses (Schuman and Presser, 1981).

It was in conducting survey questionnaire research and analysing the results of those surveys that the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of adopting sustainable ICT initiatives, were identified. It also facilitated the answering of the first research sub- question; 'what are the key implications of those barriers?, as respondents answered open-ended questions and offered details of how exactly they were affected by the barriers.

The Stage 2 of the research involved the circulation of the two principal surveys questionnaires: one designed for, and circulated within, the UK FHE sector and the other designed for, and circulated in, the Irish FHE sector. Similarly, to the justification for the use of surveys in The Stage 1 of this research, these surveys were both designed with an eye to finding answers to the 'how' and 'why' of possible barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives. In short, they were designed to answer to the research question more directly and

with minimal margin for doubt, whereas the preliminary surveys merely suggested that barriers existed.

3.5.1.2 The Design of the Questionnaires.

Questionnaires were chosen as a tool for gathering data for The Stage 2 of this research because they offered a suitable method of data collection from the wider field (FHE managers), allowed for a selection of both anticipated and unanticipated responses and were designed specifically to be engaging and easy to use. Questionnaires also allowed the researcher to place a value on the extent to which the barriers, if any, existed as responses were tabulated and percentage response rates were calculated. This allowed for a quantitative analysis of the qualitative responses and further triangulated the findings of the Scotland and UK SUSTE-TECH sustainable ICT case studies.

The UK FHE sector was chosen as it was the sector the researcher was most familiar with and the one in which the possible presence of barriers was originally identified. The Irish survey was added in order to add another geographical dimension to an already robust and reliable dataset. In fact, including the Irish survey further triangulated the research's overall data.

The surveys were designed with the possible barriers in mind and the questions were formulated based on the outcomes of the Scotland and UK SUSTE-TECH project case studies. A total of nineteen questions were asked in each survey, incorporating both open- and close-ended questions. The survey questions were written so that answers would build on the findings from case studies and preliminary survey results that would inevitably answer the research questions.

To further triangulate and add robustness to the existing data (Gray, 2009), and to provide an additional source of evidence in the form of human affairs and behavioural events (Yin, 2009), the researcher also chose to conduct a series of follow-up semi-structured interviews with the same UK and Irish survey respondents and with new respondents too. The researcher also felt that managers were more likely to respond to being interviewed (even with the limitations of using a telephone) as opposed to completing a survey questionnaire online, particularly when the interview topic was relevant to their professional position (Saunders, Lewis, and Thornhill, 2003). The semi-structured interviews were designed to both clarify the responses to the questionnaire and to allow interviewees to add further in-depth

responses if they wished. Once responses to the semi-structured interviews started to essentially become the same, with no new findings occurring, data saturation had been reached. This added even more credibility and robustness to the research (Fusch and Ness, 2015).

3.5.2 The Stage 2 Research Paradigm.

The research paradigm for the Stage 2 of this research is mainly positivistic. This is owing to the fact that the researcher is concerned with gaining objective knowledge on the subject by using established scientific methods of enquiry. In designing and circulating the surveys, the aim was to obtain a mixture of quantitative and qualitative data on each of the barriers from professionals within the sector. In doing so it challenged the traditional notion of the absolute truth of knowledge (Phillips and Burbules, 2000) and recognised that the surveys were conducted to establish positive results regarding the behaviour and actions of humans (Creswell, 2009). Where this stage of the research is concerned it relates to FHE managers approach to adopting sustainable ICT initiatives.

3.5.3 The Stage 2 Research Methodology.

The research methodology associated with the Stage 2 of this research is abductive research. This abductive research occurs when both inductive and deductive methodologies are used to gain new knowledge on the research subject (Alrajeh, 2012). As abductive research occurs when forms of reasoning from the real world cannot be clearly described as either inductive or deductive, but instead appears to be both, it is clear that this is what occurred in this stage of the research. Abductive research (or reasoning) is a form of logical inference that seeks to find the simplest and most likely explanation for an observance (Sober, 2012), but the premise does not guarantee the conclusion. Abductive reasoning can also be described as *"inference to the best explanation*" (Josephson and Josephson, 1994).

It is a data-driven process that also depends on knowledge of the subject matter by the researcher. In many cases abductive research is not restricted to or associated with any particular methodology (Lipscomb, 2012); instead it is a means by which social researchers make new discoveries in a logical and methodologically ordered way (Reichertz, 2010). Abductive research is a form of reasoning that scientists use when they are seeking to find an explanation for unexpected findings (Holyoak and

Morrison, 2012) and often depends on knowledge of causal relationships that refer to real-world sets of possibilities. It occurs when a non-typical dataset is produced, thereby producing unexpected results, and when the best possible explanation for those results is given (Svennevig, 1997).

Most importantly and very relevant to this research, abductive research occurs when the research framework is successfully modified. These modifications may occur, partly as a result of unanticipated empirical research findings but also from theoretical insights that are gained during the research process (DuBois and Gadde, 1999). The Stage 2 research methodology can therefore be considered abductive as the conceptual framework of this research was modified when underpinning barriers and absence of other barriers were found. It also occurred when the same barriers were found in other FHE institutions, business and local authorities as discussed in Chapter 2, section 2.11.5 and 2.11.6. In fact, throughout The Stage 2, the researcher was open to new findings and surprises which is precisely what occurred. While aspects of both inductive and deductive methodologies were used in this research they are not considered abductive *solely* for this reason. Abductive research has more to do with theory development than theory regeneration and this is precisely what happened in The Stage 2 of the research. The researcher was attempting to establish *if* the barriers existed, what they *might be* and to what extent as oppose to attempting to establish the certainty of their existence.

> This research is deductive because its objective was to discover new things namely other variables and relationships in the data enabling new knowledge on the research subject to be obtained. Where the phenomenon of the existence of barriers was tested, using established scientific research methods in The Stage 1 of this research, the opposite occurred in the Stage 2 of this research. The UK and Irish surveys, designed with answering the research questions and sub-questions in mind, were circulated. A non-typical dataset produced unexpected results and the best possible explanation for those results was given. Abductive inferencing is not, a mode of reasoning that delivers new knowledge, and neither is it an exact method that assists in the generation of logically ordered hypotheses or some new theory. Instead, abductive inferencing is an attitude towards data and towards one's own knowledge: data are to be taken seriously and the validity of previously developed knowledge is to be queried:
>
> "*It is a state of preparedness for being taken unprepared*" (Reichertz, 2010, p.6).

These are precisely the conditions of The Stage 2 of the research.

3.5.4 The Stage 2 Research Methods: Mixed Methods.

The research methods for Stage 2 are essentially mixed**.** Mixed methods of research typically occur when inductive research is being conducted, but this pairing of methodology and methods is not exclusive to one another. In fact, advances in mixed methods of research design encourage researchers to consider using both types of questions (qualitative and quantitative) and to employ different types of survey format such as interviews and online questionnaires. Survey research is, in and of itself, a large heterogeneous family of methods that includes survey questionnaires, which do not fit tidily into either a qualitative or a quantitative box (Andres, 2012). They are therefore considered to be abductive research. While the methods are mainly quantitative since the data are in numerical format, there are aspects of qualitative data too as many of the comments left in the open-ended questions further inform the research.

The Stage 2 also incorporates elements of comparative research, correlation research and evaluation research. As mentioned earlier, research does not have to be purely qualitative or quantitative; it can be a combination of both. Similarly, the types of research carried out do not have to fall solely under one category or another. They can be a combination of more than one, or indeed many. This is precisely what occurred throughout the Stage 2 of the research. As Bergman stated in 2008, '*trying to separate the two approaches in an attempt to downplay or dismiss one of them only serves to hamper the rich findings that only a mixed method survey can produce*' (Bergman, 2008, pp.11–21).

Datasets from the UK and Irish surveys are compared with one another to draw comparisons on the existence of the barriers in both countries. The fundamental reason for the use of mixed methods of research is that the use of quantitative and qualitative data together provided a better understanding of research problems than either approach alone (Creswell, 2006). Also referred to as "hybrids" (Ragin, Nagel and White, 2004) "methodological triangulation" (Morse, 1991), and "combined research" (Creswell, 1994), the mixed methods approach used in this research provided strengths that offset the weaknesses of the quantitative and qualitative data that would have existed had the questionnaire been purely one or the other. This has been the historical argument for mixed methods of research for the last thirty-

eight years (Jick, 1979) and one which the researcher felt was the most appropriate to gather the necessary data that would ultimately answer the research question.

Where this research was concerned, quantitative research alone would have weakened the reader's understanding of the context or setting, and inhibited their ability to discuss the responses. Whereas adding qualitative questions to the questionnaire compensated for those weaknesses and made the research more robust.

Since qualitative research alone is sometimes regarded as being biased because of the personal interpretations made by the researcher and the way in which questions are sometimes worded, the UK and Irish questionnaires also included quantitative questions, thereby minimising these weaknesses. The mixed method of research employed in this investigation, provided more a comprehensive collection of evidence when attempting to identify the barriers and limiting factors. Adopting mixed methods provided more robust data than either quantitative or qualitative methods alone. In fact, researchers are expected to use as many data collection tools available, rather than just those typically associated with qualitative or quantitative research only (Teddlie and Tashakkori, 2009). Overall, The Stage 2 of this research was essentially an examination of social science in an FHE setting, so choosing the mixed method approach simply broadened it, leaving it in many ways complete (Creswell, 2006; Berg, 2009; Bryman, 2001).

3.5.4.1 Semi-Structured Interviews.

Holmes, Moody, and Dine (2006, p.177) define an interview as being a meeting convened between a researcher and a participant. Semi-structured interviews are more flexible, non-standardised interviews that are typically used as part of qualitative research (Robson, 2002; Saunders, Lewis and Thornhill, 2003).

The research had a list of questions related to a specific topic to be discussed during the interview, but there was no strict order to the questions and a more relaxed and flexible approach was adopted. Interviewees consisted of respondents from the main survey but also FHE managers not previously interviewed. This allowed for further data triangulation and also added a dynamic of input with a fresher perspective. Questions were modified based upon the researcher's perception of what question were most appropriate to ask (Robson, 2002; Freestone, 2012). The order of the questions changed depending on the emergent responses (Gray, 2004).

Semi-structured interviews contribute to case-study evidence, as they relate to human affairs and behavioural events (Yin, 2009). Where this research is concerned, it was employed in the hope of providing further evidence of the independent variables. According to Kane and O'Reilly-De Brün, (2005) via Tipping (2011), the semi-structured interview relies upon an agenda that covers the relevant points and acts as an aide-memoire, but with the actual questions framed to the respondent and the situation (Tipping, 2011).

This researcher's semi-structured interviews were conducted via telephone in order to eliminate travel time and expense for both the interviewer and the interviewee (Bryman, 2001). One of the benefits of adopting semi-structured interviews as part of The Stage 2 research was that FHE managers indicated in the UK and Irish surveys a preference for being interviewed via telephone as opposed to completing an additional follow-on survey questionnaire (Saunders, Lewis and Thornhill, 2003). This research conducted a series of semi-structured interviews to further validate the presence of each of the barriers and add robustness to the data. A total of 15 semi-structured interviews were carried out as a follow up to the responses of the larger UK and Irish survey. Participants were a mixture of ICT/IT managers and environmental/sustainability managers and a detailed analysis of respondents answers are given in Chapter 5 section 5.52.

3.5.5 The Stage 2 Types of Research.

The types of research used in The Stage 2 are **comparative research, correlation research and evaluation research.**

3.5.5.1 Comparative Research.

Comparative research is the study of the dynamics between two or more social relations (May, 1993) and this is shown in Chapter 5, Analysis of UK and Irish Survey Results. In this chapter, data from the UK and Irish surveys are compared and contrasted from a social standpoint. A fundamental difficulty encountered in social research is finding intelligent answers to pressing real-world social problems where a large number of variables are highly interrelated, resulting in their cause and effect proving difficult to detangle (Blalock, 1970). Comparing objects or datasets is essential to basic scientific and philosophic inquiry. Scientists have been using this form of investigation for more than 2,000 years (Deutsch, 1987 via Dierkes, Weiler,

and Antal, 1987) and this is why it was used in this stage of the research. Comparative research also allowed the researcher to reveal the origins of, and any development of social phenomenon, placing them in a specific place or time and therefore identifying any contributing factors (Walliman, 2011). As comparative research is the act of comparing two or more things with the intention of discovering something unique about one or each of the objects being compared, this method was used to compare the various datasets and outcomes of both the UK and Irish surveys. Once all the data had been gathered, compared and evaluated, The Stage 2 of the research was complete and the barriers and limiting factors had been effectively identified. The research sub-question pertaining to the key implications of those barriers had also been answered.

3.5.5.2 Correlation Research.

Another type of research adopted in the Stage 2 was correlation research. This body of correlation research examined the association or relationship between two or more phenomena. Findings were expressed in numbers in order to find meaning between the various research phenomena. Statistics were used and presented in tables (Walliman, 2011; Schmidt, 2012). This type of research was ideal for this study, as much of the data being examined were quantitative (i.e. percentages of responses for each question) and were correlated to establish any links to other phenomena.

3.5.5.3 Evaluation Research.

The final type of research adopted in The Stage 2 of this research was evaluation research. This dealt with the complex social issues of institutional progress towards improved sustainable performance. It moved beyond simply examining facts and helped make sense of other human, political and cultural factors that appeared to be inhibiting the realisation of the potential benefits of sustainable ICT initiatives in the FHE sector (Patton, 1990). Evaluation research aims to make sense of unusual phenomena and to come to a greater understanding of occurrences (Guba and Lincoln, 1989). This is exactly what The Stage 3 of the research did when it examined the underlying cultural, political and personnel problems within FHE institutions. It also identified where and how those problems might be considered as barriers and limiting factors to realising the benefits of sustainable ICT initiatives. At

this point, The Stage 3 of the research: creation and implementation of an ICT solution that would overcome each/some of those barriers, commenced.

3.6 The Stage 3: Implementation of the ICT Solution: Action Research via The Energy Detectives Web App.

The Stage 3 of the research incorporates the implementation of a technology-based energy-saving initiative at Goldsmiths, University of London. It demonstrated how the three most commonly found barriers were overcome. The Energy Detectives project reduced ICT - (and light) - related energy wastage across campus, while at the same time engaging stakeholders in reducing energy waste and facilitating lacking managers.

3.6.1 The Stage 3 Research Paradigm.

The Stage 3 research paradigm is positivistic, however it is, by some authors, considered to be deductive as the research is controlled, is scientific in nature and based on traditional scientific methods that generate numerical data (Gray, 2009). Deduction typically begins with an expected pattern (ICT energy being wasted) that is tested against observations (engagement with the Energy Detectives' web app) and this is what is occurring during the Stage 3 action research (Babbie, 2010). It is also concerned with "*developing a hypothesis or hypotheses based on existing theory, and then designing a research strategy to test the hypothesis*" (Wilson, 2010, p.7).

The action research involves implementing the Energy Detectives project and focuses on the collection and examination of empirical data, which is used to answer the research sub-questions: creating an ICT solution that may alleviate the effects of barriers and limiting factors and where possible identifying the benefits of the use of such technology in universities and colleges.

3.6.2 The Stage 3 Research Methodology.

The Stage 3 of this research's methodology is deductive, has positivistic aspects to it and its research methods are quantitative and objective, so are therefore also empirical (Jeppsen, 2005). Data in The Stage 3 of the research are scalable and

measurable (Tipping, 2011, p.97), as they are in the form of kWhs, CO_2 emission and pounds sterling (£).

3.6.3 The Stage 3 Research Methods.

The method used in The Stage 3 of this research was **quantitative** research, as it is research that contains data with a metric value from a controlled environment and is scientific in nature. The Stage 3 was based on traditional scientific methods, generated numerical data in the form of kWh, hours and seconds which were ultimately equated into £ and tCO_2 emissions. This research sought to establish a causal relationships between the variables, using statistical methods to test the strength and significance of the relationships. This quantitative research included testing the theory (formerly the phenomenon) that comprised the variables. The analysis involved comparison of "before and after" data that were hard and reliable (Hoxley 2004 via Crabtree 2010). Quantitative research strategies are generally, though not exclusively, associated with a positivist, deductive methodology. (Macpherson, Brooker and Ainsworth, 2000; Cohen, Manion and Morrison, 2011).

3.6.4 The Stage 3 Types of Research.

The types of research used in The Stage 3 were action research and social research**.**

3.6.4.1 Action Research.

Action research is the process of systematic reflection, enquiry and action carried out by individuals about their own professional practice in order to improve it (Costello, 2003). It has been described as a model of work practice as well as a model for research by Winter and Munn-Giddings (2005). The same authors suggested that it provides a mechanism to bring professional practice and research together, creating a 'culture of inquiry' and in doing so can identify and record best practice (Winter and Munn-Giddings, 2005; Frame, 2013). It is important to make the distinction that action research is research *in* action as opposed to research *about* action (Coghlan and Brannick, 2005) and where this research is concerned, it is part of the daily remit of the researcher in her role as Environmental Officer at Goldsmiths.

However, as action research is often designed to effect organisational change, it is likely to encounter resistance by those directly involved in the process, as it is often seen as a subversive exercise (Costley, Elliott and Gibbs, 2010). This was very much the case with the Energy Detectives project and was factored in during the design stages of the web app and during the design strategy of The Stage 3 of the research.

The researcher realised that, much like the resistance of institutions to participating in sustainable ICT projects for various reasons, these needed to be factored into the design of the ICT solution, in order to overcome those very barriers. For these reasons it was designed to be mobile, easy and engaging to use and report ICT related energy waste instantly. It also needed to be cost free to the user. Similar to the reasons for poor participation in The Stage 1 UK SUSTE-TECH project, it was agreed that stakeholders were likely to be resistant to participating in this sustainable ICT project too, unless it was accompanied by a financial or tangible gain (Shin, Taylor and Seo 2012). For this reason a financial reward of a £20 gift voucher as the prize in a monthly draw for participating in the Energy Detective project was also provided.

The Stage 3 of this research mainly involved action research, which is deductive by nature as it was essentially bringing about change after the principal theory was confirmed, refuted or modified (Gray, 2009). When it comes to generating new and practical knowledge that can be used by members of large organisations in solving problems, action research is often introduced.

This action research required an individual (the researcher) who possessed an in-depth understanding of a complex social process and who through methodical reflection, could devise an action research strategy that is open to intervention for change over time (McNiff, 2010). Where this research is concerned, the complex social process was the identification of the barriers and limiting factors of UK and Irish FHE institutions implementing sustainable ICT initiatives. Assuming that the action research strategy can be controlled in an attempt to monitor and measure it, then it has the potential to improve an individual's professional performance and practice. This will ultimately lead to social and institutional change while simultaneously enabling the researcher to integrate their personal and professional learning (Reed and Procter, 1995). This is essentially what occurred at Goldsmiths where the research for professional doctorate was combined with the with the role of Space, Environmental and Sustainable Officer. An ICT solution was designed to overcome the barriers and limiting factors that were inhibiting the realisation of the

potential benefits to FHEs of adopting sustainable ICT initiatives. Named the Energy Detectives web app, it subsequently helped reduce Goldsmiths ICT energy waste, as it engaged with stakeholders and proved to be a useful tool for under resourced-managers (Hogan, 2016).

Action research was chosen as it provides in-depth insights into practice from an 'insider perspective'. Hopkins explains it as one which '*combines a substantive act of research and disciplined enquiry with a personal attempt to understand practice while engaging, improving and reforming it*' (Hopkins, 2002, p.42) and essentially learning from direct work experience (Kemmis and McTaggart, 1992, p.25).

Similarly, Waterman et al. argue that 'action research is a period of inquiry that describes, interprets and explains social situations while executing a change intervention aimed at improvement' (Waterman et al., 2001, p.11 via Frame, 2013). Frame adds that 'this improvement can also affect the performance of the researcher as they reflect on changes made'. This is essentially what occurred at Goldsmiths as action research added a unique dimension to the personal development of the researcher as well as her practice. It proved to be a powerful tool that bridged the gap between theory and practice thereby linking the conceptual with the practical (Winter and Munn-Giddings, 2005) which is essential to a doctoral degree (Trafford and Leshem, 2012). Figure 3.1 and Figure 3.2 illustrate the cycle of action research, both generally (Figure 3.1) where this research is concerned (Figure 3.2).

Design of the Action Research Cycle.

Figure 3.1 Illustration of Action Research.

Source:Melinda Kolk, 2016.

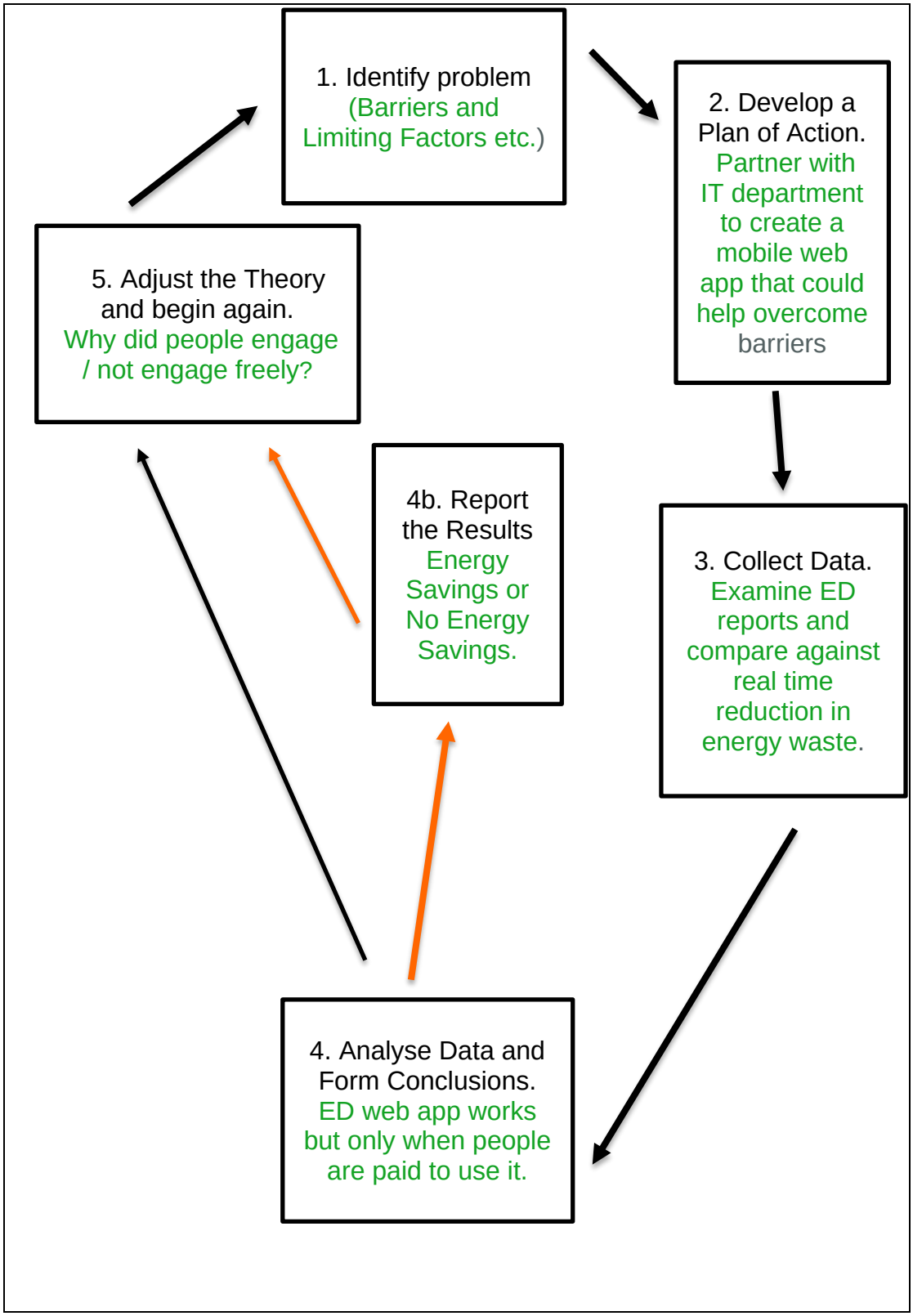


Figure 3.2 Illustration of the Cyclical pattern of the Action Research of this Research.

Figure 3.2 pertains to Action Research at Goldsmiths and the use of the Energy Detectives web app. The coloured arrows indicate the ongoing development and progression of the ED web app. The green text pertains to the actions of the researcher.

Action research has also been described as "*an emergent enquiry process in which applied behavioural science knowledge is integrated with existing organisational knowledge and applied to solve real organisational problems. It is concerned with bringing about change in organisations in developing self-help competencies in organisational members and adding to scientific knowledge. It is an evolving process that is undertaken in in a spirit of collaboration and co–inquiry"* (Shani and Pasmore, 1985, p.439 cited in Coghlan 2011). It is for this reason that it was selected for this project.

This is essentially what was employed when implementing the Energy Detectives initiative across campus at Goldsmiths, University of London. The change that this initiative generated was essentially social research (Bryman, 2014). This is not surprising as action research and social research are typically found to accompany one another. Action research conducted with an intention of creating social justice emphasises a commitment to social transformation, and challenges power relations, shows solidarity and recognises and uses emotions. In short, it is "*being the change you want to see*" (Keifer-Boyd, 2012, p.203).

3.6.4.2 Social Research

As social research is the means by which social scientists understand, explain and predict the social world, this body of research possesses considerable elements of it. This social research was carried out for a number of reasons: exploratory, descriptive and explanatory. It was conducted to gather information and data that would contribute to social change by creating a more just and fair society that is all-inclusive and reflective of the time (Babbie, 2010; Bentz and Shapiro, 1997).This particular body of research drew on the social sciences for conceptual and theoretical inspiration and was motivated by a desire for change in society (Bryman, 2014), more particularly for change within the FHE sector regarding the uptake of sustainable ICT initiatives as part of an overall carbon management strategy. This social change stemmed from the outcomes of the Energy Detectives project which occurred in the form of action research at Goldsmiths, University of London. Stakeholder engagement and issues pertaining to lacking managers at Goldsmiths,

University of London were improved via action research into the creation and implementation of a mobile ICT solution that overcame some of the barriers identified. The practical outcomes of this social research by means of action research via the implementation of the Energy Detectives web app, demonstrated that improvements to the sector are possible. When the action research was being conducted at Goldsmiths, the same principles of ethics applied; confidentiality of the identity of those who reported energy waste and assurance that the data was being used for the benefits of the institution as opposed to assigning blame to any individual or department for energy waste.

Table 3.2 Summary of the research stages, their paradigms, methodologies, methods and types of research.

Stage of Research	Paradigm	Methodology	Methods	Type of Research
Stage 1. (Green ICT project manager with the EAUC). Noticing a pattern of non-participation in green ICT projects, identifying a gap in knowledge.	Anti-positivistic.	Inductive.	Qualitative. via preliminary surveys, case studies, e-mails, ICT project progress reports.	Descriptive research, correspondence research, case study research, survey questionnaire research.
Stage 2 Circulation and examination of the results of UK and Irish survey questionnaires.	Positivistic and empirical	Abductive.	Mixed. -via the UK and Irish surveys containing close- and open-ended questions. Also known as abductive methods.	Comparative research, correlation research, evaluation research, survey questionnaire research.

Stage of Research	Paradigm	Methodology	Methods	Type of Research
Stage 3. Finding an ICT based solution to the barriers and limiting factors via implementation of the Energy Detectives web app.	Positivistic.	Deductive.	Quantitative. via cost and carbon savings as a result of reduction in energy wastage.	Action research and social research.

Similarly, in Table 3.3 the research question, the sub-questions, their methods and justifications for their use are summarised.

Table 3.3 Justification of the methods used in answering each of the research questions and sub-questions.

Question and sub-questions.	Method	Justification
What are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives? (The Stage 1 and The Stage 2).	Mixed. (Qualitative and quantitative) (via preliminary and the main UK and Irish surveys, case studies, e-mails, ICT project progress reports)	Optimal methods of gathering credible, reliable and robust data.
What are the key implications of those barriers? (The Stage 2).	Mixed. (Qualitative and quantitative) (via the main UK and Irish surveys)	Optimal methods of gathering credible, reliable and robust data that was obtained from those experiencing the barriers.
How can a sustainable ICT solutions alleviate those barriers? (The Stage 3).	Quantitative. (via engaging with the Energy Detective web app).	Direct information from those using the ICT solution to alleviate the barriers and examination of energy savings.

3.7 Ethical Considerations.

Ethical considerations need to be undertaken when conducting research (Collis and Hussey, 2003. pp 37–40) and each ethical aspect of what is being proposed should be carefully considered (Robson, 2011). The principal ethical considerations of this research project were ensuring that data gathered were done so legitimately and not in a coerced fashion. It was essential for the researcher to consider each of the ethical aspects of what was being proposed. It was also important that participants in surveys and those being interviewed felt they could trust the interviewer with any confidential or sensitive information being given (Banks and Gallagher, 2008). This was done by including a written guarantee of confidentiality at the start of the main survey informing participants that all answers would remain confidential. A similar verbal guarantee was given prior to conducting the semi-structured interviews. In addition, every e-mail, included as part of the various datasets and appendices, had personal information removed. Each of the interviews was carried out in a professional, non-biased manner where survey and questionnaire participants felt at ease and respected (Oliver, 2010; Parrot, 2010).

Each of these measures was taken in accordance with ARU's ethics policy and the researcher completed the compulsory ARU ethics online training course. All the necessary paperwork related to research ethics was submitted to ARU's Faculty of Science and Technology research ethics panel and was ultimately accepted (Anglia Ruskin University, 2016).

Another ethical consideration of this research was the possibility that staff incompetency might have been revealed that could have resulted in embarrassment or demotion of those concerned. Any pressure interviewees may have felt during the research or indeed after the results of the research were published was also considered. To avoid the risk of this happening the names of interviewees remained confidential. A full ethics application was submitted to and approved by the ARU Ethics Committee prior to conducting any research. Social researchers in particular are expected to carry out research tasks in an ethical manner (Denscombe, 2010).

Throughout the research participants were ensured that any information given would be used exclusively for the doctoral study and would not be passed onto a third party or be used for any other purpose (Appendix XV). It was made clear throughout the research that participation was entirely voluntary and that participants could withdraw at any time without prejudice or negative consequences.

All of the data collected was handled in compliance with the Data Protection Act 1998 and responses were stored in a password-protected location.

3.8 Summary of Chapter 3.

This chapter outlines the three different stages of this research and the paradigms, methodologies and method used in each of those stages. It explains the meaning of each paradigm, methodology and method and justifies why each one was applicable for that particular stage of research.

This chapter also includes a description of the various different types of research used throughout each of the three stages and how they each contribute to answering the research question in a unique way.

A section on reflection, and more specifically, critical reflection and its role in "raising the level of thinking" of practitioners is included. So too is the relationship between the critical reflections of this research and how it spurred cultural and social change at Goldsmiths. The importance of the inclusion of valid and reliable data is also discussed and how sparse data can severely undermine and in some cases negate the research outcomes. Finally, the ethical considerations given to this research are included and an explanation as to how participants in this research were made to feel relaxed and confident in the level of confidentiality of their responses is also given.

3.8.1 Chapter 3's Scholarly Contribution.

The **overall scholarly contribution** of this chapter is the means by which it offered a description of the datasets and how they were gathered, analysed and ultimately contributed to answering the research questions. The research implications of this chapter include the creation of clear-cut explanations and justifications of each of the paradigms, methodologies, methods and categories of research adopted, for all three stages of the research that facilitated the collection of data. It allowed the author to understand the research a little more deeply and to see it for what it was i.e. a three-stage research project.

It also enabled the researcher to make comparisons of it to other research theses. The researcher also gained new knowledge about research methodologies and methods which resulted in a greater appreciation of the work already completed.

Literature review is essential for developing a theory from an existing concept and the literature review on this research's methodologies (both conforming and conflicting literature) proved central to informing and directing the study (Huberman and Miles, 2002). It resulted in a better research framework and led to an

understanding of where the research sits within the myriad of the various different types of methods and categories of research and to a justification of the methods used.

The methodology chapter enabled the description and categorisation of the research and, after having read supporting literature on the subject, has made it easier to understand, justify and explain why those methods, paradigms and methodologies were employed. Huberman and Miles (2002) also stated that "*literature review connects concepts, theories and hypotheses not necessarily previously connected with each other*", which gives confidence that the path taken was indeed correct.

The inclusion of conforming literature with like findings is important. This can result in theory that has a

> "*stronger internal validity, wider generalisability, and higher conceptual level*" (Huberman and Miles, 2002, p.25).

Trafford and Leshem (2009) go further by showing that theories generated from the literature continue to generate greater understanding through a process of summary, synthesis and analysis. Engagement with the literature facilitates the development of the theoretical perspectives that underpin the research (Trafford and Leshem, 2009).

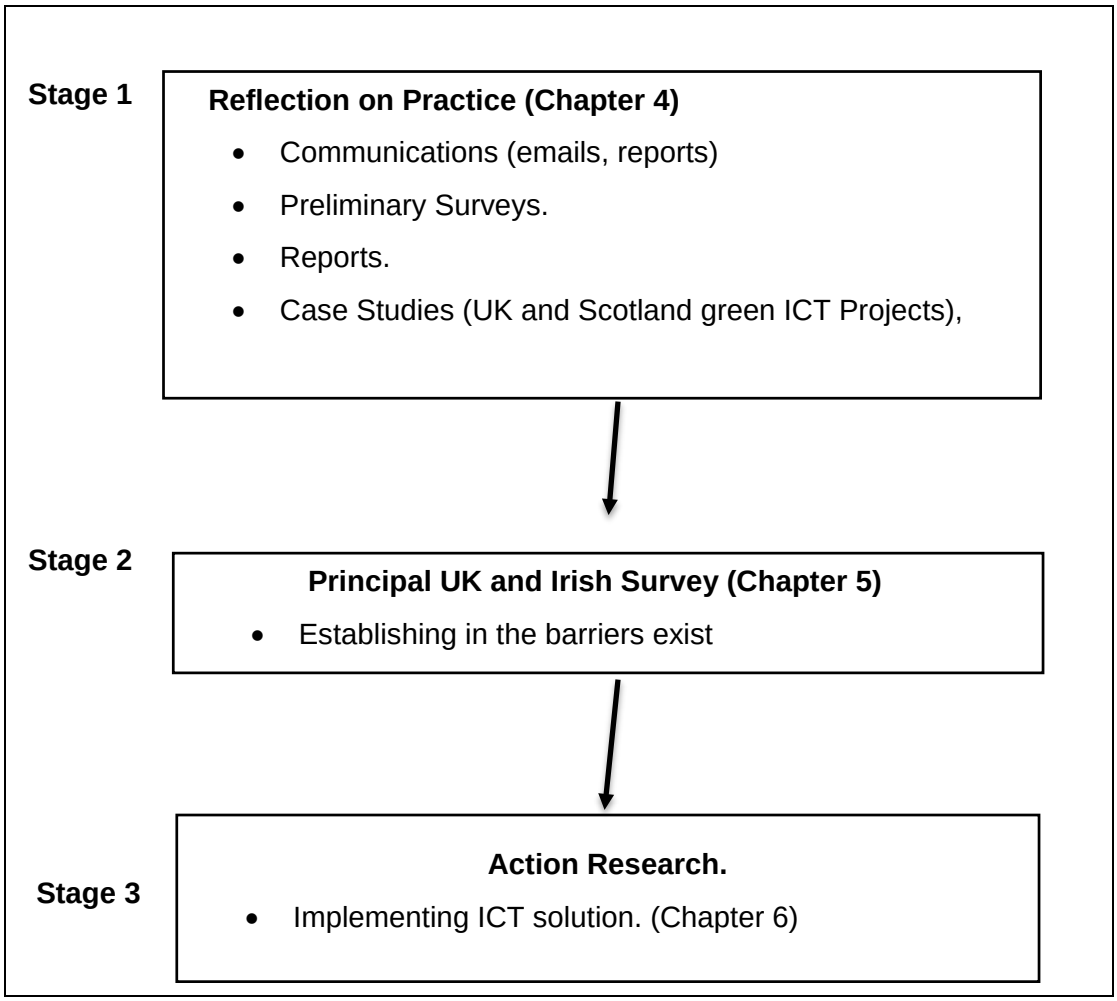


Figure 3.3 Illustration of the Flow of this Research from Stage 1 to Stage 2 to Stage 3.

The Stage 1's reflection on practice of this research evolved to include the management of the research's two principal case studies, the Scotland ICT Carbon and Energy Management project and the UK SUSTE-TECH project. The following chapter, Chapter 4 offers a detailed synopsis of both those case studies. It explains how they helped shape the researcher's experience of working in the sector which ultimately led to the identification of the gap in knowledge and subsequently the formation of the research questions.

Chapter 4. Sustainable ICT Projects: The Case Studies.

4.0 Introduction

This chapter introduces the two case studies chosen as part of this research. They include the 2009 Scotland ICT Carbon and Energy Management Project and the 2010 UK SUSTE-TECH project. These case studies were chosen as the researcher had first-hand experience in managing them while working as the sustainable ICT project manager with the EAUC, so was familiar with their objectives, progression of their action plans and their final outcomes. In fact, it was the outcomes of these case studies in particular that contributed to the researcher realising that a gap in knowledge within the FHE sector existed. They are essentially the preliminary data gathered as part of The Stage 1 of this research. These case studies are essentially the social phenomenon described in Chapter 3 (section 3.4.5.3) and provide a rich source of data that allowed the researcher to reflect on problems within the sector. A full description and analysis of how this preliminary data was gathered is included in Chapter 3 sections 3.4.1 : The Stage 1: Gathering the Preliminary Data to 3.4.5.5: Designing the Survey Questionnaire.

This chapter also introduces the government bodies that funded each of the projects, the organisations that sponsored and delivered them and the carbon accounting tool, the SusteIT Tool that was central to both case studies. The outcomes of both projects are included, as is a conclusion as to why they both ended with “lessons learned” as opposed to “key factors to success” despite the financial and consultancy support offered. This chapter also explains how the outcomes of both projects were central to the researcher’s decision to conduct further investigation into possible barriers to universities and colleges participating in sustainable ICT projects. The research is effectively “zooming in” (Kapogiannis and Sherrat, 2016) on what the barriers might be and why they exist. Finally, this chapter explains how the conceptual framework for this research was developed. It explains how on reflection on both the Scotland and UK case studies, the researcher realised that a gap in knowledge regarding the implementation of sustainable ICT initiatives within the FHE sector existed. Further reflection by the researcher resulted in the conception of the research question, sub-questions and ultimately the conceptual framework. The conceptual framework shows the relationship between the possible barriers and the principal research question, as well as the interdependent and underpinning relationships between the possible barriers themselves.

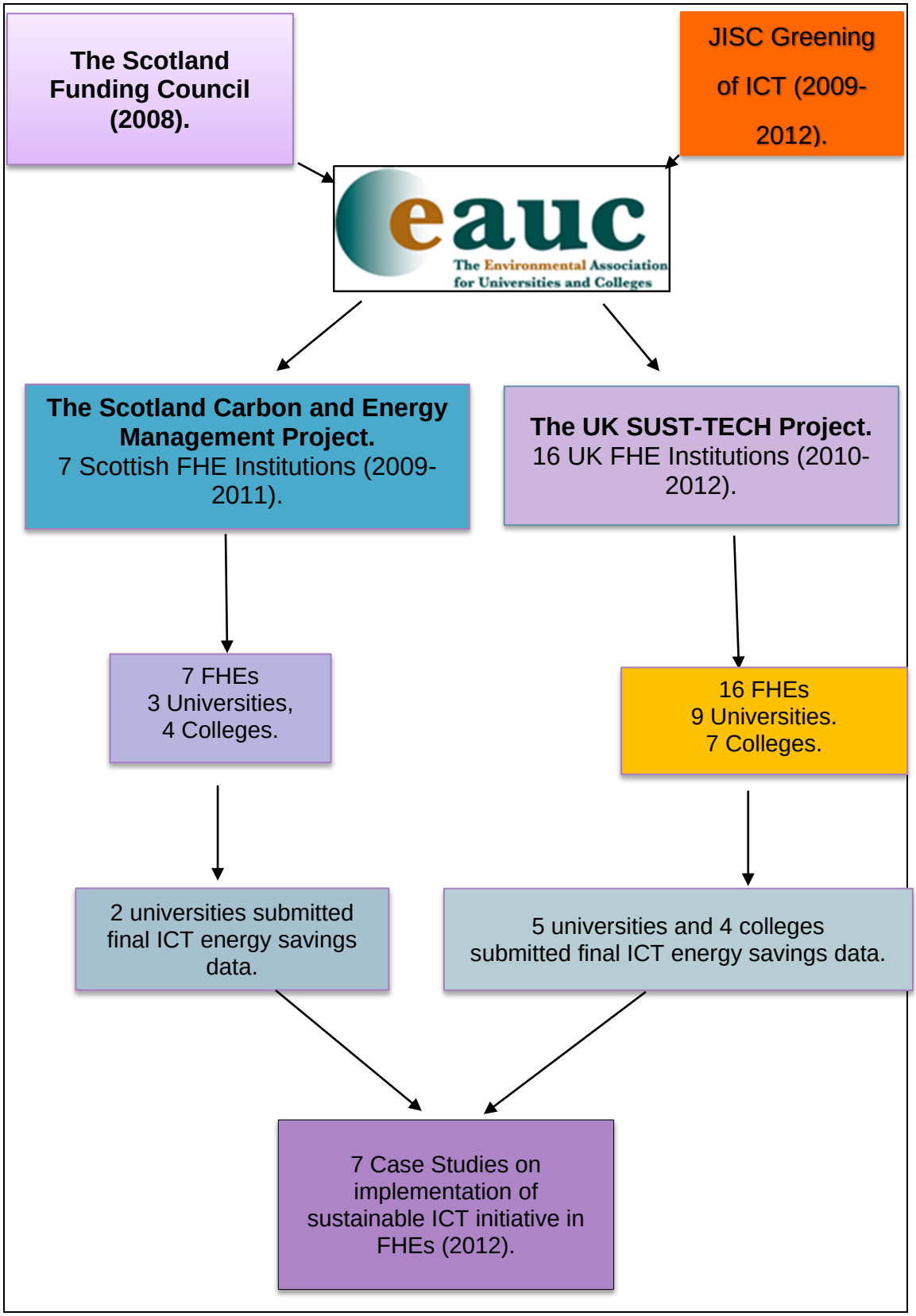


Figure 4.1 Flow-diagram indicating relationship between Scottish and UK Funding Organisations, The EAUC, and the Green ICT projects.

Figure 4.1 illustrates the flow of the relationship between The Scotland ICT Carbon and Energy Management Project and the UK SUSTE-TECH project, their funding bodies and the organisation that sponsored them, the EAUC. It illustrates how out of a total of twenty-three FHE institutions in Scotland and the UK, only eleven institutions submitted final data and of those eleven institutions, only seven submitted sufficient data to be worthy of a case study.

4.1 JISC's Greening ICT programme.

JISC's Greening ICT programme was a multi-stage and a multi-strand programme that funded a variety of green ICT projects undertaken by various FHE institutions. The UK SUST-TECH project was one of these projects. Commencing in September 2009 and ending in December 2012, the programme's intended outcomes were to demonstrate:

1. A reduction in the ICT-related carbon footprint and associated energy costs within the sector;
2. An increased capacity and level of expertise in sustainable ICT across the sector;
3. An improved reputation of the sector and of the UK as leaders in sustainable ICT;

   and

4. A reduction in e-Waste created along with an increase in recycling of ICT equipment.

These were also the intended outcomes of the Scotland and UK SUSTE-TECH projects. Participation in both projects required the use of the SusteIT Tool, completion of a Green ICT Action Plan and the signing of a Memorandum of Understanding. All three documents acted as aids to baselining, measuring and monitoring institutional energy use as well as a reminder of the commitment the project required.

4.1.1 The Suste IT Tool.

As its acronym suggests, the SusteIT (Sustainable Information Technology) Tool was the name given to the Excel-based carbon accounting tool in JISC's first sustainable or "green" ICT project. Named the SusteIT project, it commenced in 2008 and ran until 2009 and was delivered by the University of Bradford's Higher Education Environmental Performance Improvement Initiative (HEEPI) programme. The project investigated ways in which ICT within the sector could be used more sustainably and was part of JISC's wider strategic Green ICT Programme. It highlighted the increasing importance of monitoring ICT energy use in FHEs and its associated CO_2 emissions and running costs. The SusteIT Tool was central to the SusteIT project and listed each of the categories of ICT equipment a university or college typically used. Those categories included PCs and monitors, servers and data centres, telephony and audio-visual (A.V.) equipment, printers and copiers. The tool consisted of columns to input quantities of equipment from each category of ICT along with the average number of hours in operation. Once populated with the relevant data, the tool would automatically calculate the carbon and energy costs associated with their use to save energy. Institutions could then identify which categories of ICT equipment were consuming the greatest amount of energy and make more sustainable decisions regarding their use. The tool also allowed for easy comparison of each category of ICT equipment as data were presented in both pie and bar charts. This enabled users to instantly see which category of their ICT systems made up the greatest percentage of their overall ICT energy use (See Figure 4.2a and Figure 4.2b).

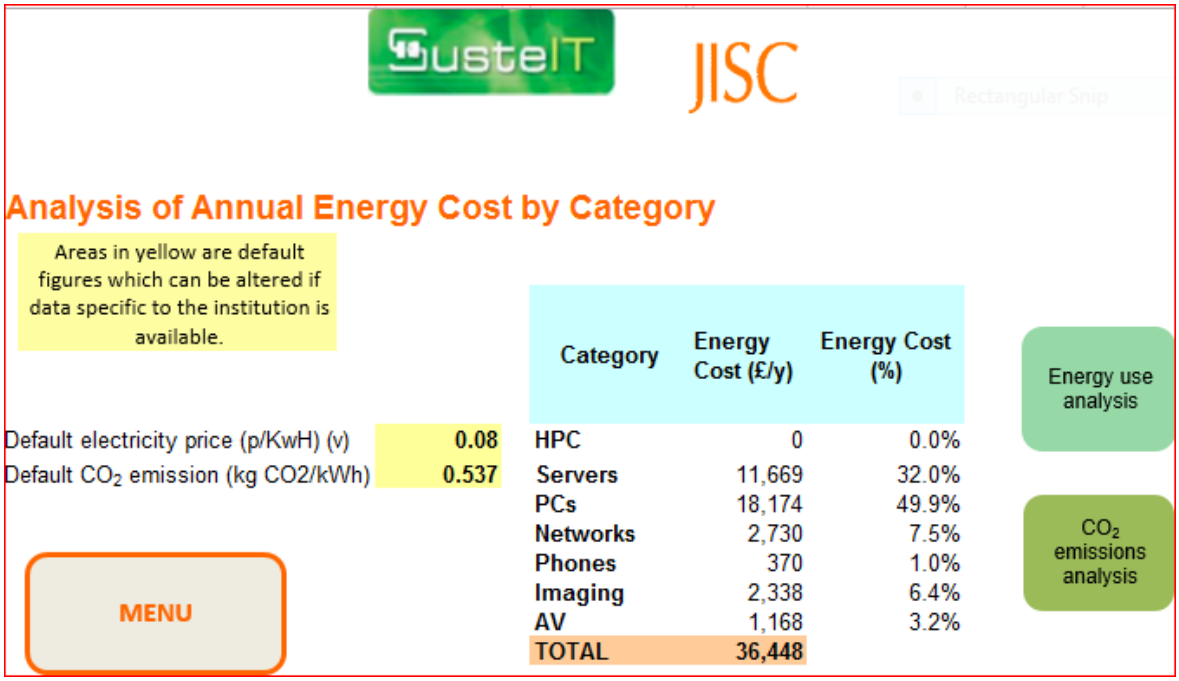


Figure 4.2a SusteIT Tool's Analysis of Annual Energy Cost by Category, Cost (£) and % of total ICT Energy Use.

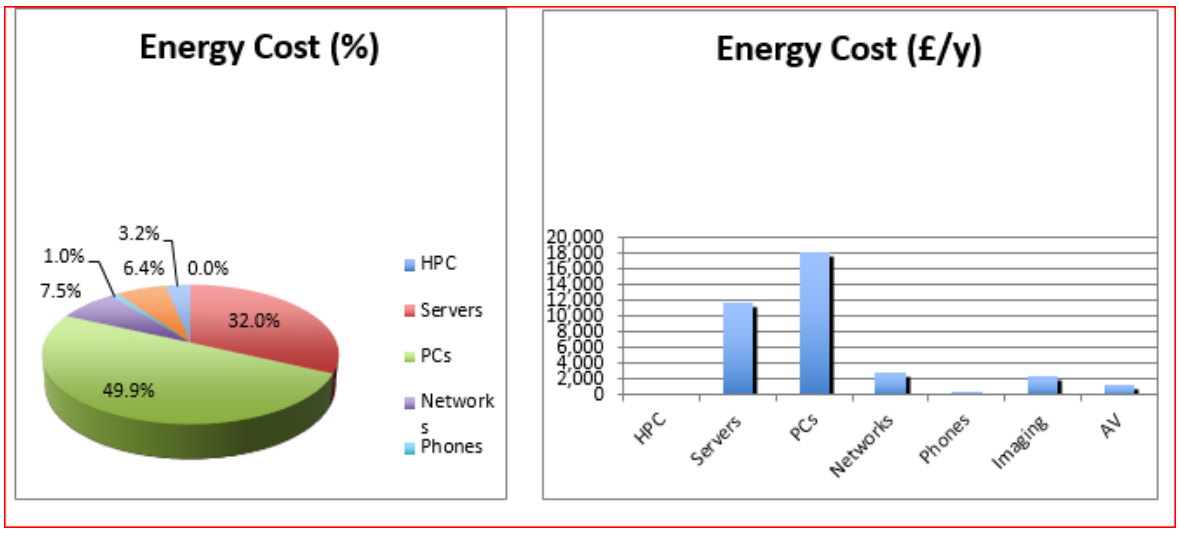


Figure 4.2b SusteIT Tool's Analysis of Annual Energy Cost by Category, Cost (£) and % of total ICT Energy Use.

Finally, as with all Excel-based tools, it allowed for the transformation of data in each of the columns so users could see potential savings when substituting with the data of greener ICT (JISC, 2009; SusteIT, 2009). This tool was central to both the Scottish and the UK SUSTE-TECH projects, and therefore played a key role in this research. It made the categories of ICT equipment that consumed the greatest amount of ICT energy easy to identify, thus taking the guess-work out of sustainable decision-

making. For example, the tool demonstrated that at the University of Liverpool, PCs and monitors were the greatest consumers of energy, which subsequently influenced their decision to install PC PowerDown, a software program ensuring an automatic switch to sleepmode for PCs not in use. This initiative alone saved the university £60,000 in running costs in one year (Sustainability Exchange, 2016c).

4.1.2 The Green ICT Action Plan.

Another tool used to aid participants in implementing more sustainable ICT initiatives was the Green ICT Action Plan. This action plan was a Word document outlining the green ICT initiatives that each institution planned on implementing in order to reduce ICT-related energy use and was compulsory for participation in both the Scottish and UK projects. Each action plan included the name of the participating institution and the name of the contact point as well as a statement of commitment from the institution to fully participate in the project which included completion of the SusteIT Tool. The action plan also listed the time-frame of implementation and the anticipated benefits of each of the green ICT initiatives. Finally, institutions were asked to indicate the support they would like from the project in the implementation of their action plans and were invited to leave comments about the project (Appendix V).

4.2 The Scotland and UK Sustainable ICT Carbon and Energy Management Projects.

In July 2008 the Scottish Funding Council (SFC) provided the EAUC with funding to deliver a sustainable ICT carbon management programme. The Scotland Sustainable ICT Carbon and Energy Management project for Scottish universities and colleges became part of that programme. In 2009, JISC provided the EAUC with funding to deliver a similar sustainable ICT project, but in UK universities and colleges only. Named the UK SUSTE-TECH project, it was part of JISC's wider Greening of ICT programme and commenced in January 2010. Both projects (the Scotland project and the UK SUSTE-TECH project) had the same aims, objectives and deliverables.

Both projects aimed at;

1. Examining the ICT-related energy consumption and carbon emissions of universities and colleges, thus establishing a baseline dataset of their ICT energy use through the use of the SusteIT Tool.

2. Encouraging each of those institutions to reduce their ICT-related energy consumption through the use of more sustainable ICT technology (thin client, virtualisation, PC PowerDown, etc.) over a period of twelve months.

3. Demonstrating and quantifying the reduction in ICT-related energy use through a “before and after” comparison of completed SusteIT Tools.

4. Disseminating the information and data gathered on university and college ICT-related energy use to other interested parties such as other FHE and educational institutions, government agencies, local authorities, libraries, small-to medium-sized enterprises (SMEs) etc.. Commencing in February 2009 and in January 2010 respectively, both were delivered by the EAUC with support from HEEPI and various JISC Regional Support Centres (RSCs).

The aim of both projects was to promote the use of the SusteIT Tool in order to:

1. Establish institution-specific ICT-related carbon baselines upon which to deliver measurable improvements in ICT carbon emissions, energy use and cost;
2. Build a larger baseline dataset of the ICT-related energy use and wider environmental impacts of the Scottish and UK FHE institutions.

Despite the level of support institutions were, however, asked to:

1. Implement initiatives at their own cost and ensure that funding was already secured for implementing their sustainable ICT initiatives;

2. Provide a single point of contact (typically an ICT, energy or environmental manager) who would provide updates to the SUSTE-TECH project manager on the progression of their ICT action plan;

3. Submit a baseline of ICT related data and updates on improvements in a timely fashion to the Scotland and UK SUSTE-TECH project manager, thus enabling a “before and after” assessment of any improvements made; and

4. Sign a Memorandum of Understanding to this effect (Appendix VI).

While the researcher was not part of the Scotland Sustainable ICT Project when it initially commenced, it is understood that recruitment of its participants was problem-free.

4.2.1 The Scotland Project

The Scotland Sustainable ICT Project recruited seven participants in total, comprising of four colleges and three universities (Chamberlain, 2011). Participants were sent the SusteIT Tool and asked to populate it with data relating to their institutions' current selection of ICT equipment and number of hours in use each day over a twenty-four hour period. They were also asked to submit to the project manager a completed ICT action plan and to sign their memorandum of understanding.

Participants submitted their baseline data at the start of the project and in April 2010, after a year of implementing their ICT action plans, were asked for an update on their progress. Six of the seven Scottish institutions submitted an update of sorts although none included an updated SusteIT Tool. In 2011, the UK SUSTE-TECH Project manager i.e. the researcher took over the Scotland project and during the course of the following nine months met with its various participants to discuss any barriers they may have been experiencing. At the project's end in September 2011, only two institutions submitted a final update and by November of that year the project had ended. The Scotland Sustainable ICT Carbon and Energy Management Final Report stated that while overall the response rate of participants in the project was very poor, initial intentions were described as being "good" and action plans as "ambitious yet realistic".

The conclusions of both reports indicated a combination of financial pressures, staff turnover, managerial restructure and competing priorities as being the reasons for not having submitted data. Four of the six participants had changed or abandoned their agreed ICT action plans. However, while the results were disappointing, the project was successful in gathering evidence of good practice within the sector (Chamberlain, 2011).

4.2.2 The UK SUSTE-TECH Project Year 1.

Recruitment for the UK SUSTE-TECH project was slow-paced. Running from January 2010 to February 2012 the project comprised of sixteen further and higher education (FHE) institutions from the York and Humberside, south west and south wales regions. The sixteen institutions were comprised of nine universities and seven colleges. The criteria for participation in this project were the same as the Scotland project and feedback from managers regarding difficulties in participating was also similar to that of the Scotland project, with the majority of managers unable to gather data due to lack of resources. SUSTE-TECH participants were unable to purchase new greener ICT equipment due to cuts in funding, having no help from resource staff to support the project, existing staff already being overworked and the majority of participants having no spare time to devote to the SUSTE-TECH project.

However, unlike the Scotland project, in November 2010, the SUSTE-TECH Committee decided to revise the participation requirements that limited participants to either the York and Humberside or the south west and south wales regions of the UK. Institutions from across the UK were then invited to participate. An additional revision included the SusteIT Tool no longer being required to calculate energy improvements for participation as it was proving too time-consuming to gather the necessary data to populate the tool. Instead an updated Green ICT Action Plan demonstrating ICT energy savings would suffice (Appendix III). A further ten institutions then submitted their applications and by December 2010 the recruitment stage of the project was complete. Sixteen UK FHE institutions from the York and Humberside, south west and South Wales region had submitted, completed or part completed applications for the SUSTE-TECH project. December 2011 marked the end of Year 1 and the start of Year 2 of the SUSTE-TECH project.

4.2.3 The UK SUSTE-TECH Project Year 2: Stage 1 of the Research.

It was agreed by the SUSTE-TECH committee that Year 2 of the project would focus on the wider dissemination of the use of greener technologies and kick-start the communication and networking between green ICT companies, environmental managers and ICT/IT managers within the sector. Part of this communication included the SUSTE-TECH project manager organising green ICT workshops, writing blogs, tweeting, arranging meetings with SUSTE-TECH participants and the circulation of green ICT-related surveys. The intention for SUSTE-TECH Year 2 was

that through the use of social media, workshops and face-to-face meetings, the profile of green ICT would be raised and managers would realise the benefits of its use.

Year 2 of the SUSTE-TECH project also became The Stage 1 of the research. It was during this time that the researcher carried out a series of surveys to gather qualitative data that would ultimately identify the gap in knowledge. The same data was also used to contribute to answering the research question. The second year of the SUSTE-TECH project also knows as The Stage 1 of this research employed an inductive methodology that had an anti-positivistic paradigm.

4.2.4 UK SUSTE-TECH Surveys

The SUSTE-TECH project manager wrote and circulated to the wider FHE management community four surveys over the course of SUSTE-TECH project. Those surveys were circulated to a combination of sector-specific managers and the wider FHE managers who subscribed to the EAUC's mailing lists. Those surveys included;

(i) The Procurement for Green ICT by ICT/IT Managers Survey;
(ii) The Procurement Managers' Knowledge of Green ICT Survey;
(iii) The Green ICT Strategy Survey; and
(iv) The Cuts in Funding Survey.

Each of the four surveys aimed at establishing a greater understanding of possible barriers to universities and colleges participating in either the Scotland Sustainable ICT Carbon and Energy Management project or the SUSTE-TECH project.

(i) The Procurement for Green ICT Survey by ICT/IT Managers.

The Procurement for Green ICT survey was circulated in November 2010 to ICT/IT managers *only*. It aimed at establishing their existing knowledge of green ICT and it also aimed at obtaining a better understanding of any restrictions they may have faced when requesting newer, greener technologies from their departments. It also aimed at establishing if they were members of their institution's sustainability committee and/or contributed to making sustainable decisions regarding the

purchase of ICT equipment. It established the background of the respondents as regards their length of time working in their current roles and working in the sector, their presence or absence on environmental committees and whether this was a request by the committee's chair or if it was part of their job description. Respondents were also asked about their responsibility towards greening their institution's ICT systems to establish if being on the committee could actually effect change.

86.36% (nineteen) of survey respondents stated that their input was requested when their institution purchased ICT equipment and 13.64% (three) stated that it was not. Of the 86.36% of respondents who said that it was, they were asked their opinion on a range of ICT equipment. Figure 4.3 summarises the types of technology-related issues ICT managers are in charge of.

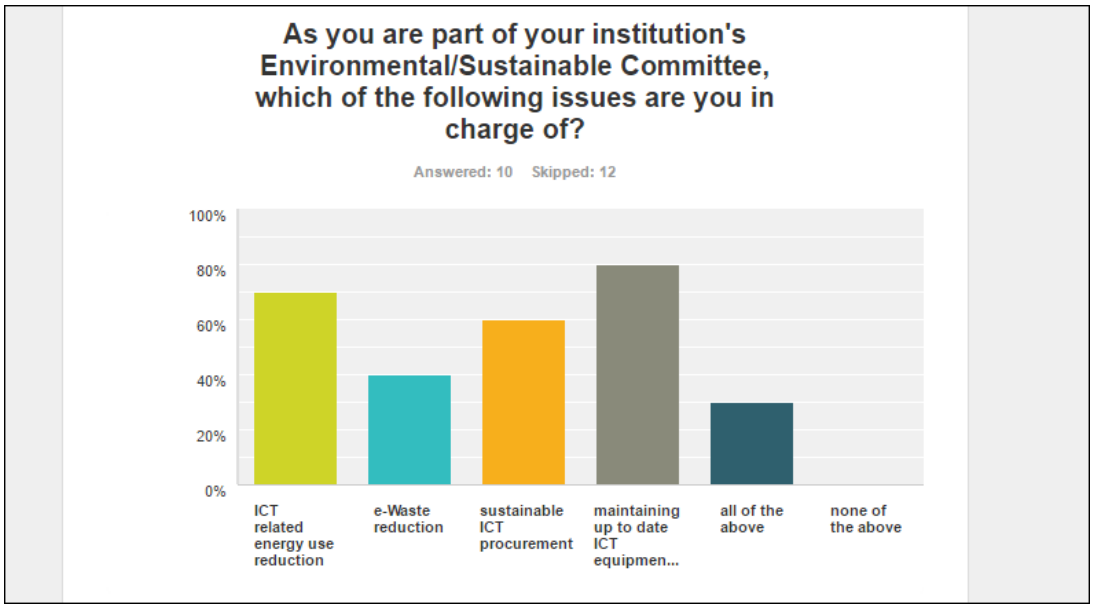


Figure 4.3 Types of technology-related issues ICT managers are in charge of.

82.35% (fourteen) of ICT managers were asked for their input regarding the cost of purchasing new ICT equipment; the remaining 17.65% (three) were not asked. When it came to the energy requirements (kWhs) of ICT equipment, only 35.29% (six) stated that their input was requested, but the majority, 64.71% (eleven) of ICT managers opinions, was not. When asked if they were aware of the "End Use Energy Services" directive requiring institutions to purchase equipment that is energy-efficient in all modes, including on standby mode, 58.82% (ten) of ICT managers stated that they were and the remaining 41.18% (seven) stated that they were not. However, despite the somewhat conflicting results regarding ICT managers' input

into certain aspects of the purchase of ICT equipment for their institution, the majority of them, 82.35% (fourteen), were asked for their input regarding various other aspects of ICT equipment's use such as size, colour, performance and software compatibility. The remaining 17.68% (three) were not, indicating a mixture of both good and bad communication between ICT/IT managers and procurement managers in institutions where the purchase of ICT equipment is concerned. This may be regarded as an example of poor stakeholder engagement and/or lacking managers and therefore the existence of a barrier. A more detailed analysis of this survey is included in Appendix XI.1

Respondents were asked a series of questions regarding their intuition's provision of them with sufficient information on advancements in greener technology, including permission to attend green ICT conferences and workshops and subscriptions to green ICT journals and sustainable magazines. 70% (fourteen) stated that they were and 30% (six) stated that they were not. When asked about e-Waste, respondents stated that they were both aware and not aware of the ICT-related packaging regulations to the same extent. However, 100% (twenty) of respondents indicated that their ICT suppliers comply with WEEE regulations (Waste Electrical and Electronic Equipment). Respondents also offered useful information regarding features and attachments most often disposed of and which they consider to be unnecessary as well as favourite categories of ICT equipment considered to be both user-friendly and better for the environment.

Finally, when asked about being aware of government targets relating to CO_2 emission reductions and energy efficiency, 85% (seventeen) of survey respondents stated they were aware and 15% (three) stated they were not. Staying on the subject of carbon emissions, 64.71% (eleven) of respondents stated that their institution *had* set CO_2 reduction targets, with 35.29% (six) stating that they *had not*. When asked specifically what their institution's CO_2 targets were, comments included specific percentage reductions by set dates, comments that targets had already been achieved, not being sure what the targets were and institutions not yet having their targets agreed, but planning on it. A more in-depth and detailed analysis of this survey is given in Appendix XI.1).

Summary of Results of Procurement for Green ICT by ICT/IT Managers Survey.

To summarise, this survey highlighted the disparity of knowledge and understanding ICT managers have regarding sustainable ICT and the benefits of its use. The

majority of responses were positive and indicated that ICT managers in a variety of roles were aware of the environmental impacts the use of an ever-increasing selection of “kit” causes. This survey also provided valuable information as regards the single category of kit that contributes to e-Waste and the fact that even managers who are not as actively green in their roles as they could be *are* interested in being greener. Overall FHE institutions appeared to have included their ICT energy consumption as part of their wider carbon and energy management plan and were on track to achieve their carbon targets (Hogan, 2011a). However, this survey also showed that barriers to implementing sustainable ICT initiatives do in fact exist. The input of almost 14% of ICT/IT managers input is not requested when their institution purchases ICT/IT equipment. They are not asked about price or energy use of ICT/IT equipment, nor are they asked about size, colour, performance or software compatibility. More than 41% of ICT/IT managers are not aware of aware of the "End Use Energy Services" directive and 30% of managers were not provided with sufficient information on greener ICT by their institution, despite 80% of that 30% stating that they would like to be provided with such information. Half of the respondents knew nothing about packaging regulations or if their institution used WLC tools. Finally, some survey respondents indicated knowing little about their institutions CO_2 targets or if their sustainable ICT performance was being restricted by supplier contracts. Each of the negative responses indicated that the barriers of poor stakeholder engagement, lacking managers, government organisations as poor drivers and budget-holders and decision-makers, existed.

(ii) The Procurement Managers’ Knowledge of Green ICT Survey.

Similar to the Procurement for Green ICT by ICT/IT Managers Survey, the Procurement Managers’ Knowledge of Green ICT Survey was circulated to procurement managers *only*. The aim of this survey was to obtain a better understanding of any restrictions that they may face when procuring greener technologies. Fifty-three procurement managers in total took part in the survey and this was primarily due to the survey being advertised on the British Universities Finance Directors Group (BUFDG) mailing list, reaching hundreds of procurement managers. The results proved extremely valuable to procurement policy-makers and FHE managers covering ICT, estates, energy and sustainability.

Overall survey participants had an excellent background knowledge and experience in working, not only in their current procurement roles, but in the procurement sector

in general. Almost half (47.7%) had worked for at least five years in their current procurement roles, with almost 30% having been working in their current roles for up to fifteen years. 43.2% of survey participants had worked in the procurement sector for more than fifteen years with more than 40%, having between five and fifteen years in the sector.

When asked about their knowledge of environmental/sustainable issues, almost 63% said they were quite knowledgeable on the issues with almost 30% stating that they were very knowledgeable on the issues. Less than 10% stated that they had minimal or no knowledge of sustainable issues. These results indicate that embedding sustainability into an institution's procurement process should be done with relative ease.

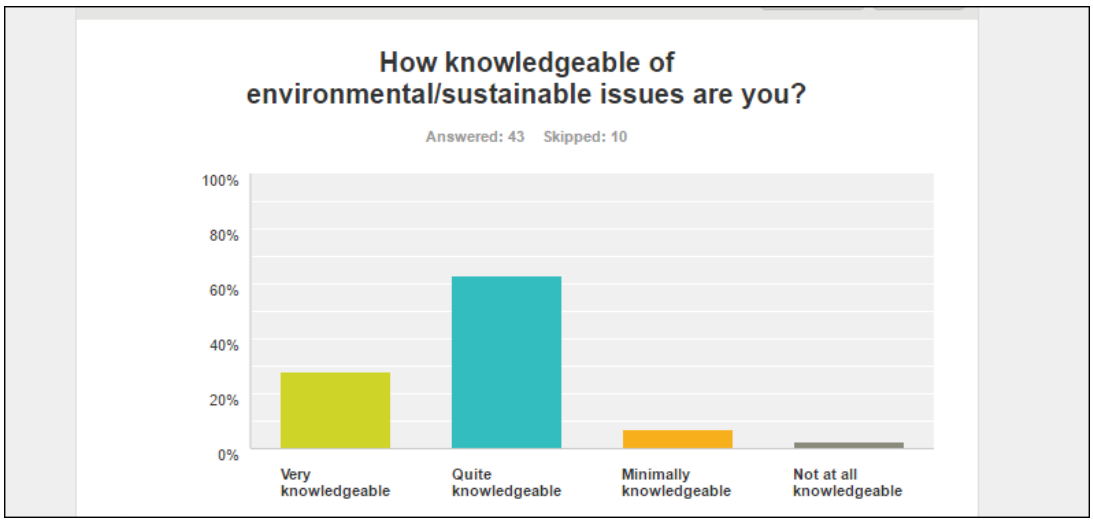


Figure 4.4 Chart Indicating Environmental/Sustainable Knowledge of Procurement Managers.

When asked about their institution's sustainable/environmental committee, 60% stated that they were part of it which means that almost 40% were not. Of those who were on the committee, more than half (52%) indicated it was a voluntary decision. This indicated that staff members were already dedicated to improving their institution's sustainable performance. Other reasons included being asked to join (40%), and it being part of their job description (24%), indicating a sustainable mindset at a higher organisational level. As shown in Figure 4.5, when asked specifically about procuring ICT equipment as part of their roles in the environmental committee, 60% of participants stated they procured energy-efficient equipment, 40% stated they procured or tendered for e-Waste contactors, 48% stated they examined suppliers' environmental credentials and almost 30% stated they examined the supply chain of ICT equipment. 24% stated they did all of the

previously mentioned with only 4% stating they did none of the previously mentioned. This indicated active participation by procurement departments in environmental committees. For a full analysis of this section see Appendix XI.2.

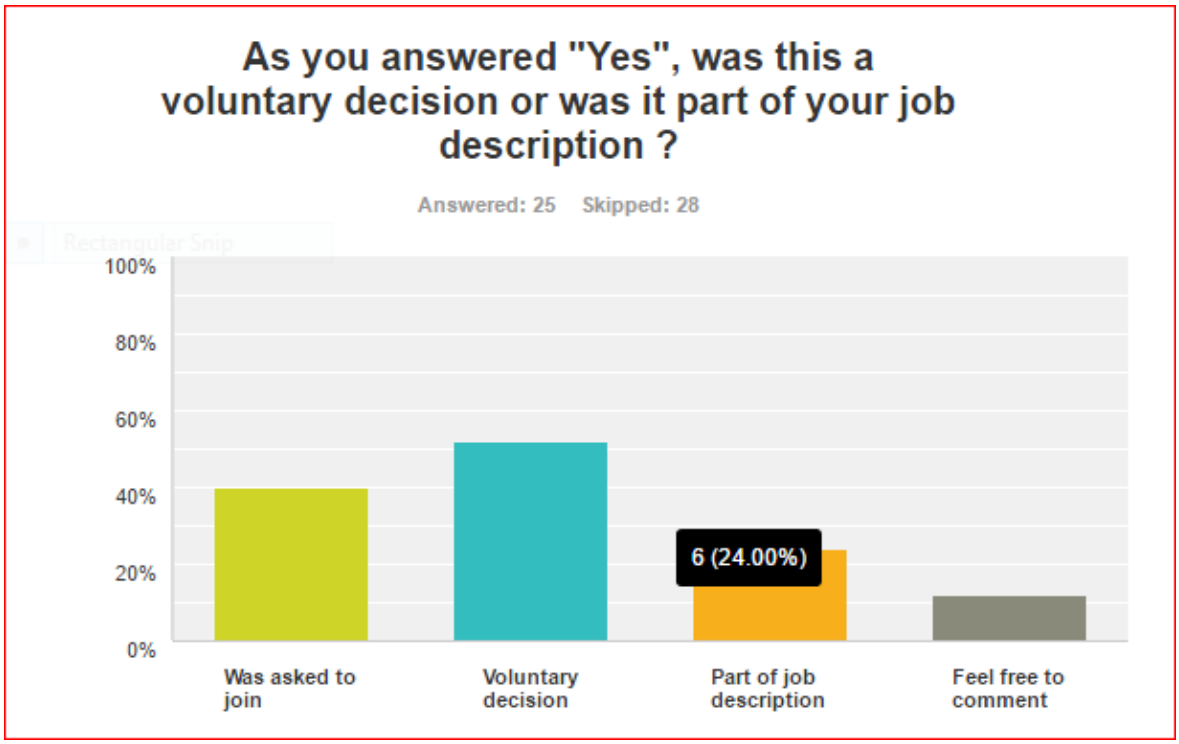


Figure 4.5 Chart indicating why staff members are part of their institutions environmental committee.

For those who were not part of their environmental committee, 47% stated that it was because they were not asked to join, almost 12% stated it was because they did not have the time to join and 17.6% said it was because there was no such committee at their institution. However, when questioned later about being asked to be on the committee, 75% stated they would join. The remaining 25% who answered *No* indicated it was only because they felt that they were already being represented or because of a lack of time and not a lack of interest in environmental issues.

To conclude, representation by procurement managers on environmental committees within the sector is particularly good but could be improved. A lack of ICT/IT manager's time proved to be the main barrier.

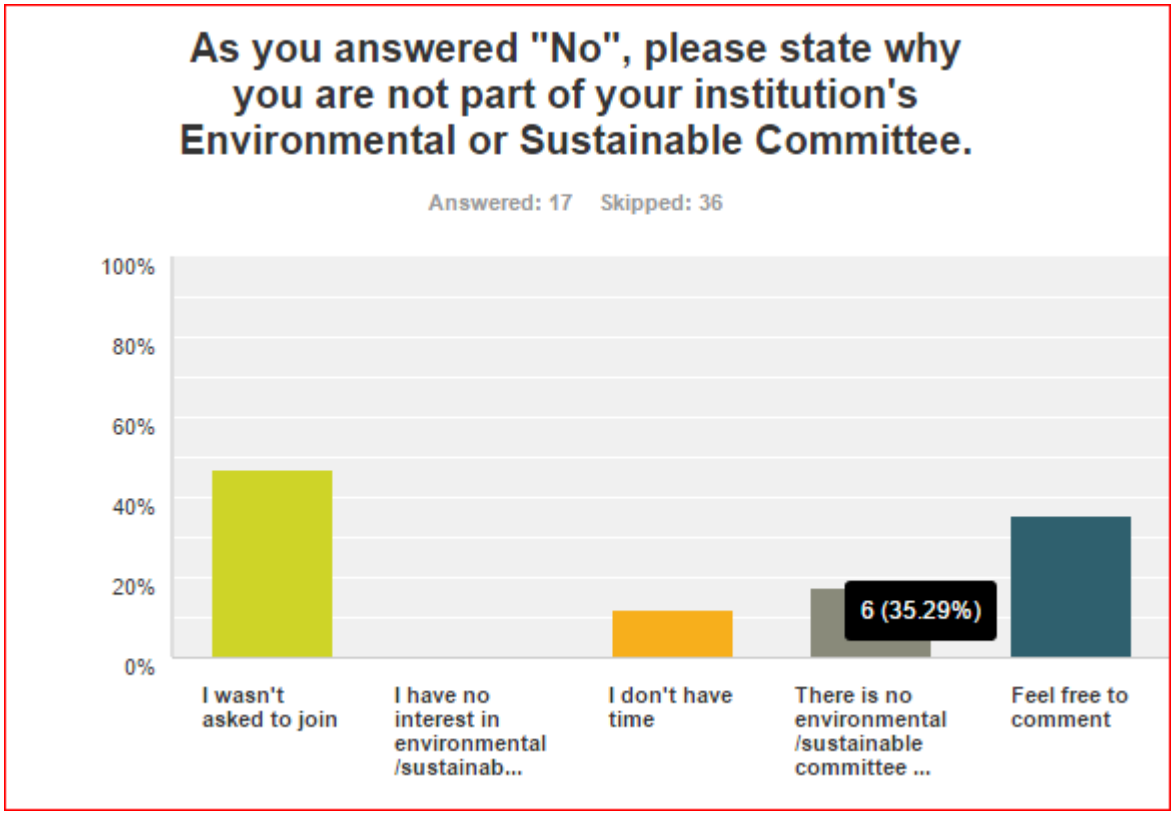


Figure 4.6 Chart indicating why staff are not part of their institution's environmental committee.

Categories of ICT Equipment Procured.

As part of their roles as procurement managers (as opposed to their roles as environmental committee members) 61% of survey participants said they procure for more energy-efficient equipment, 22% procure for e-Waste contractors, almost 40% procure for ICT equipment with a smaller ecological footprint and the same number examine suppliers' green credentials. 22% examine the supply chain of ICT equipment while 33% do a combination of all of the above. When asked if they were aware of the "End Use Energy Services" directive, half stated they were while the other half said they were not. This datum indicated that the various aspects of green ICT are covered by procurement departments, although not in every institution. When asked about being adequately provided with sufficient information on how to best procure the most sustainable technology, 63% of survey participants said that they were, while 36.8% said they were not, indicating a barrier.

The comments regarding this question included: being restricted by time in attending workshops and conferences, their institutions currently working on this area and there being too much information to choose from, leading to indecisiveness. However, 54.2% of survey participants stated that they had in fact attended green

ICT training events/conferences and workshops, 50% had attended procurement training events conferences and/or workshops and more than 45% subscribed to green ICT magazines or journals. The remaining 25% did all of the above, with just 4% stating they were not being provided with any information on green ICT at all.

Whole Life Costing Tools (WLC) Tools.

When asked about the use of Whole Life Costing Tools (WLC) Tools, almost 64% of survey participants stated that procurement and whole life costing (WLC) tools are used as part of their institution's procurement process, 22% did not, and the remaining 13.9% were unaware if their institution used a tool or not as shown in Figure 4.7.

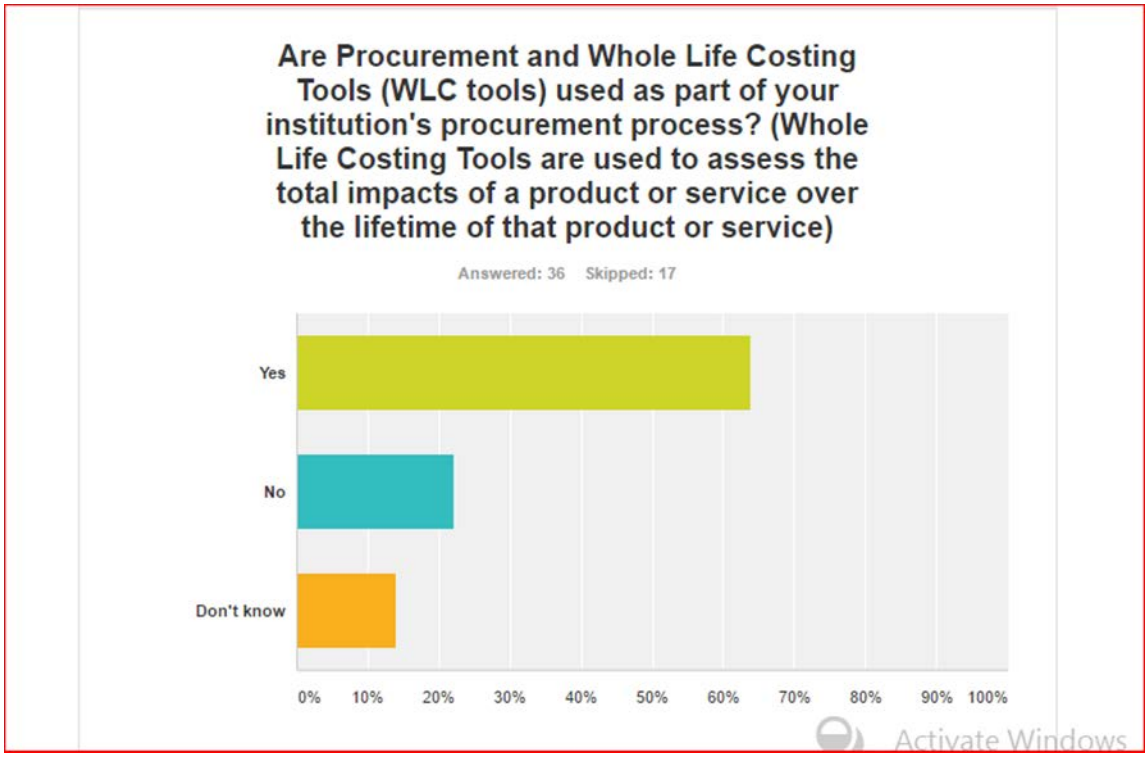


Figure 4.7 Knowledge of UK Institutional Use of WLC Tools.

Comments on this question included WLC tools being too complex and inaccurate to get a true environmental footprint (a topic that is often debated), but the remaining comments indicated institutions were either already using WLC tools or in the process of implementing the use of one.

Of the WLC tools used, almost 37% used the SPCE flexible framework tool, and only 5.3% stated they use the Forum for the Future Sustainable Procurement Tool

and its WLC and CO_2 tool. 47% stated they use their own institution-specific procurement tool with 26.3% stating their use of another tool as shown in Figure 4.8.

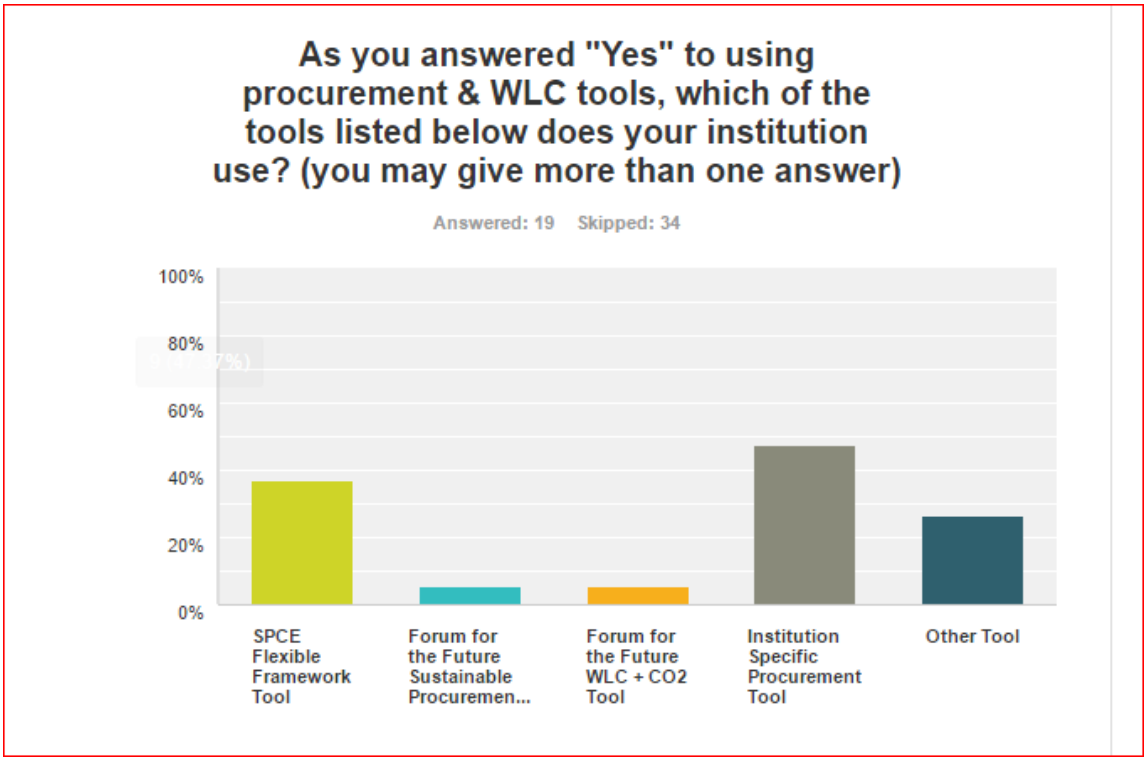


Figure 4.8 Chart indicating which procurement and WLC tools used at their institution.

Comments on this question included a list of other tools being used or simply using their own spread sheet instead. However, of those who stated they were not using a tool, almost 79% stated they would be interested in using one. 7% expressed no interest and the remainder stated they were unsure. Comments given as part of this question included the possible use of a tool providing it was accurate and easy to use. 79% of those who stated they use the HE procurement framework tool felt it covered their needs for sustainable ICT while more than 20% stated that it did not. A full analysis of the responses to this survey is given in Appendix XI.2.

CO_2 Emission Targets.

On the carbon emission and energy efficiency question, almost 85% stated that they *were* aware of the related government targets, with just over 15% stating that they *were not.* These responses are shown in Figure 4.9.

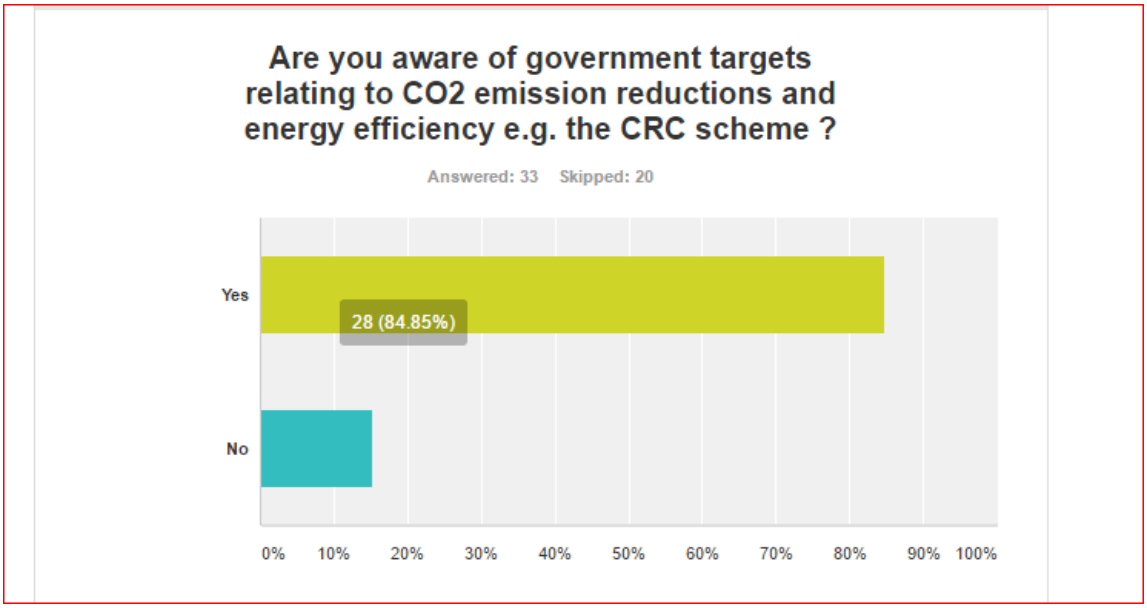


Figure 4.9 Chart Indicating staff awareness of targets relating to CO_2 reduction.

Of the 28 who that answered *Yes* to monitoring their emissions, 16 replied with exact figures; the remaining stated that their energy or sustainable manager had the figures. This response echoes the results of some of the earlier questions that indicated procurement managers' strong knowledge of sustainable issues and their willingness to champion the cause. When asked about suppliers' restrictions, more than 31% stated that they were being restricted with almost 47% stating they were not. Of those who answered *Yes*, they indicated that it was predominantly photocopier and printer contractors who restricted their ability to be more sustainable. The remaining answer options of PCs and monitors, AV equipment, telephones, networks, server room equipment, HPCs and other ICT equipment had an evenly distributed percentage of between 10% and 30%.

Measuring Value for Money.

When asked how they measure value for money when procuring sustainable ICT, thirty-one survey participants replied. They stated that measuring the overall value for money of each piece of kit included: examining the initial purchase cost; ongoing running costs; and disposal costs. Items that live up to the standards and specifications and are the least expensive are considered the items of better value. When asked what kind of changes to the traditional procurement progress they would like to see made, thirty participants gave a variety of answers, but most had overlapping points. Those points included: procurement managers being able to see

sustainability embedded more in WLC tools, less complicated tools being used and an ease on the EU procurement restrictions with more flexibility to purchase from local suppliers, thus improving their carbon footprint. In short, survey participants were in favour of anything that would make the procurement process less laborious and complicated and would also promote and support sustainability.

Summary of Procurement Managers Knowledge of Green ICT Survey.

Overall the survey indicated a very good background knowledge of sustainable issues from procurement managers and a strong presence on environmental committees. When procuring ICT equipment the most important factors, such as energy use and the life length of a product, are examined. This is not surprising, as obtaining value for money goes hand in hand with sustainability. However, some of the responses indicated scope for improvement and frustration at the often complex procurement processes. This indicated the presence of the barriers lacking managers, and budget-holders and decision-makers. While there exists an element of poor stakeholder engagement, those appeared to be the two main barriers to implementation of sustainable ICT initiatives where procurement managers are concerned. For a full analysis of this survey, see Appendix XI.2

(iii) The Green ICT Strategy Survey.

This survey was circulated to various categories of FHE managers at the start of the SUSTE-TECH project to establish to what extent FHE institutions across the UK had a green ICT strategy, or similar, in place. 58 respondents took part in this survey with a wide variety of job roles being represented from both FE and HE institutions. Respondents were asked if their institution had an ICT strategic plan (also known as an ICT action plan) in place and replies indicated that 57.89% (thirty-three) institutions had while just over 7% did not. The remaining 35.09% (twenty) did not know whether their institution had or not (see Figure 4.10).

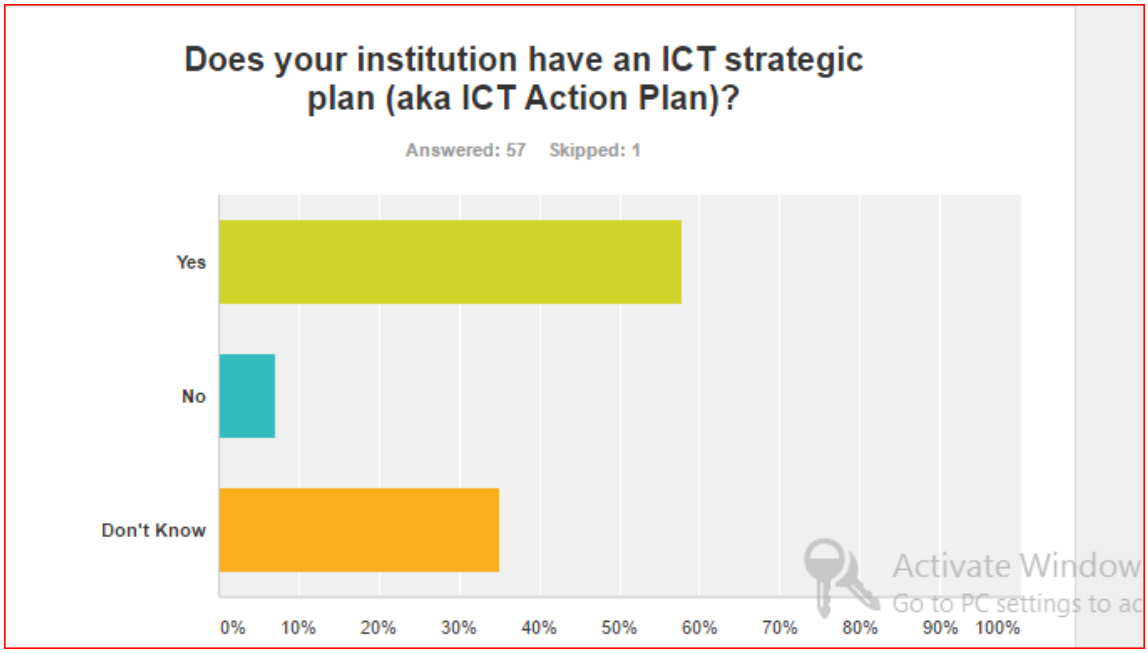


Figure 4.10 Staff Knowledge of Institutions having an ICT Strategic Plan.

Of those who answered *Yes* to having an ICT strategic plan, the respondents were asked if it included a green ICT strategy that included targets to reduce the environmental footprint of ICT operations. 60.61% (twenty) said it did and 21.21% (seven) said it did not. The remaining 18.18% were unsure.

For the respondents who replied *Yes* to the follow-on question of having a green ICT strategy, 58.62% (seventeen) said the plan included strategies for using ICT to help achieve sustainability targets and 10.34% (three) said that they did not. The remaining 31.03% (nine) stated that they did not know. Either way for respondents who answered *No* or *Don't Know* to the previous question, 61.11% (twenty-two) stated that their institution used ICT to help achieve sustainability targets, 11.11% (four) said *No* and 27.78% (ten) said they *don't know*. Finally respondents were asked if their institution specifically measured the carbon footprint of its ICT infrastructure, specifically naming the SusteIT Tool as an example. 21.57% (eleven) said *Yes*, 45.10% (ten) said *No* 33.33% (seventeen) stated that they *did not know* if their institution did or not, as shown in Figure 4.11.

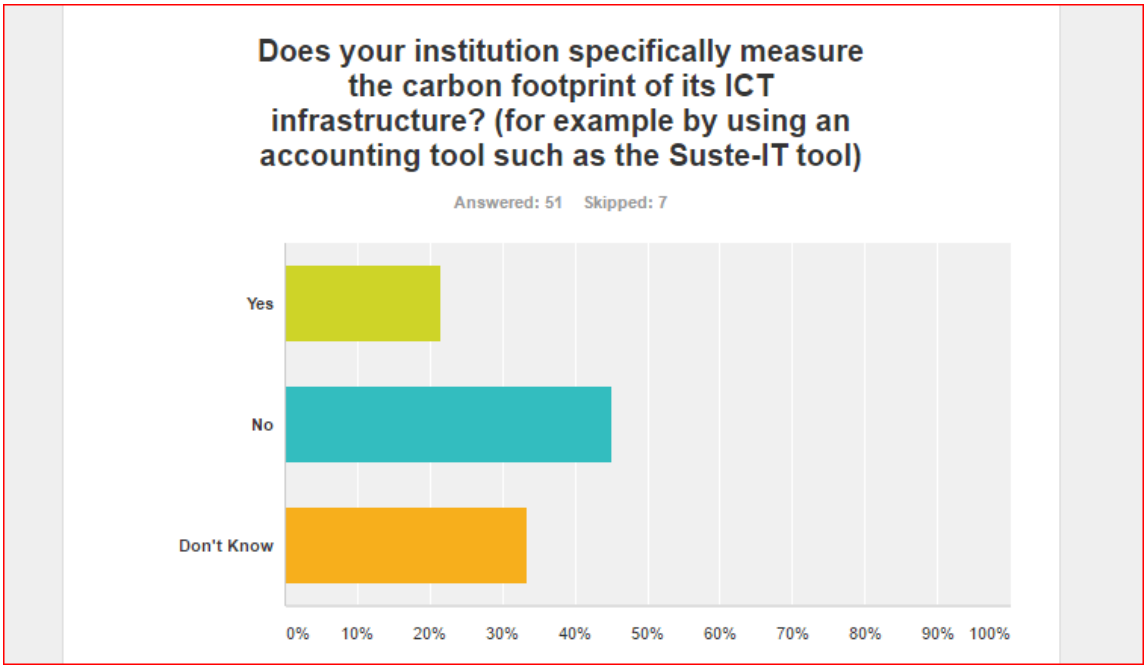


Figure 4.11 Institutions measurement of their ICT carbon footprint.

Summary of Green ICT Strategy Survey.

This survey asked about the presence or absence of a green ICT strategy within their overall ICT strategy. While responses indicated that FHE institutions have considered the environmental implication of their ICT systems, more than 56% either have not or are unsure if they have done so or not. Even where institutions indicated consideration for the environment, almost 42% had not planned or were unsure if they had planned on using ICT to help achieve sustainability targets. Where more than 78% of institutions either do not or don't know whether they measure the carbon footprint of their ICT infrastructure or not, this indicates the barrier of institutional culture. While it offered an insight into the extent of institutions' green ICT strategies and action plans, in institutions where neither strategies exist, this may be considered a precursor to being a barrier. For a full analysis of this survey, see Appendix XI.3.

(iv) Results of the Effects of Cuts in Funding Survey.

The Cuts in Funding Survey, circulated in January of 2012 was circulated to the full spectrum of FHE managers. The aim of this survey was to establish if the 2010, £600 million cuts in funding to the education and research budget as recommended in the 2010 Browne Review (Browne, 2010) had affected institutions' ability to

operate more sustainably and therefore participate in the SUSTE-TECH project. The survey was circulated to almost a thousand members of staff at various UK FHEs. 113 FHE managers participated in the survey with seventy-four of those managers (65.5% of total participants) completing the survey. Participants in the survey represented a variety of backgrounds and their responses spoke volumes about the effects that cuts in funding have on sustainable projects at FHE institutions. The majority of survey participants 36.7% (thirty-three) were sustainability or environmental managers, with ICT and energy managers coming second and third, accounting for 18.9% (seventeen) and 16.7% (fifteen) of the respondents respectively. Procurement managers and building and estates managers also participated in the survey, as did waste managers and those working in other departments. Unfortunately, neither carbon managers nor utilities managers were independently represented, although their roles may have been represented within one of the various job titles (see Figure 4.12)

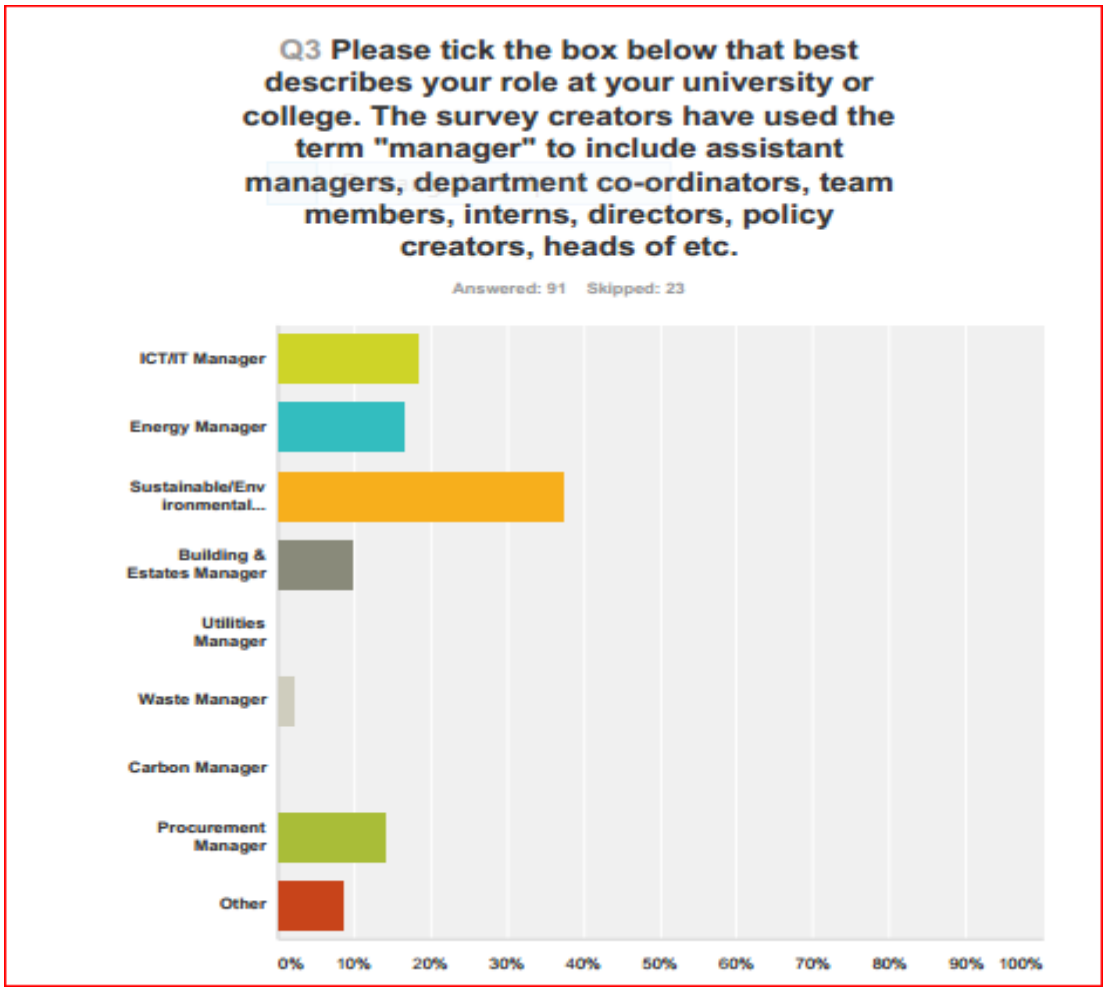


Figure 4.12 Disparity of Categories of FHE Managers who participated in the survey.

Forty-six of the survey participants (51.1%) had at least one to five years' experience in their roles, with the remainder having at least six or more years' experience, so these responses can be considered particularly valuable

More importantly however, the survey confirmed the effects that the 2010 cuts in funding had had on the sector. Results of the survey indicated that seventy-two institutions (80.0% of survey respondents) had had their funding cut since 2010, with just five institutions (5.6% of survey respondents) stating that their institution had not. The remaining thirteen institutions (14.4% of survey respondents) stated they were unsure whether their funding had been cut or not, indicating no impact on their job roles thus far (see Figure 4.13).

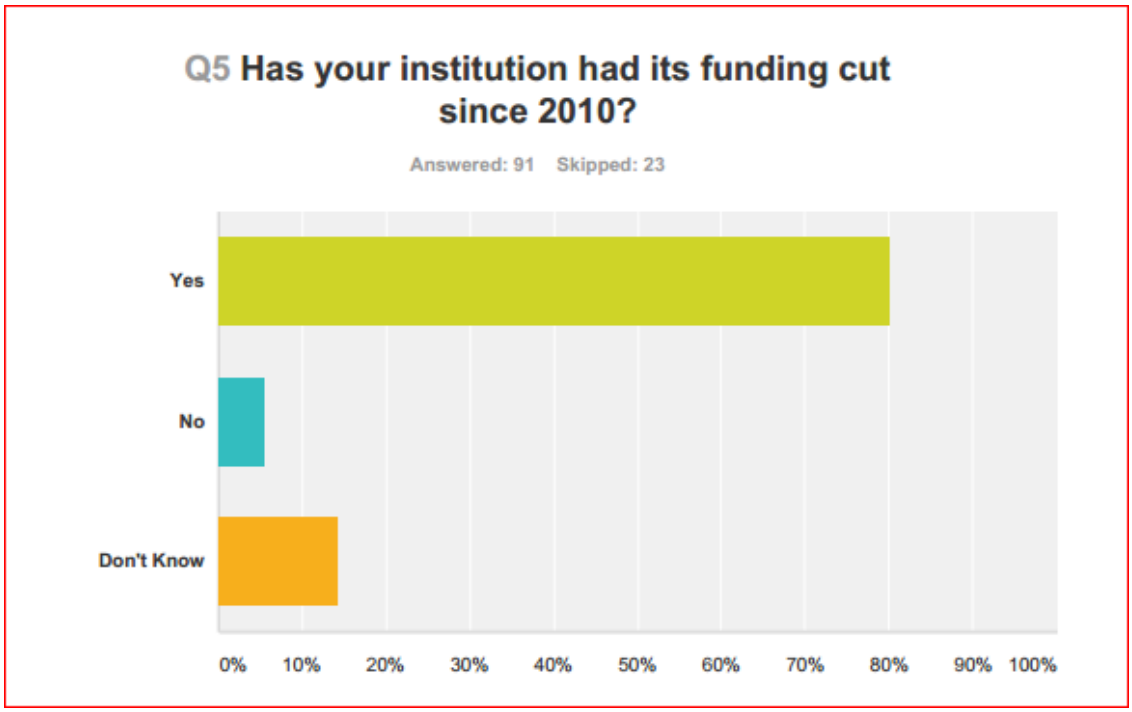


Figure 4.13 Effects of the 2010 Cuts in Funding to the Sector.

Of the institutions that stated they had had their funding cut, almost 30% (29.2% or twenty-one institutions) stated they knew by how much (with some giving the amounts in either pound sterling or percentage of total budget), with the remaining 70.8% (fifty-one institutions) stating that they did not. Reported cuts in funding varied in amounts, from up to £4 million to as much as 100% of their budget, and included a reduction in staff numbers by thirty-four for one particular institution (see Appendix XI.4). Even in respondents who replied "don't know" to having had their funding cut, 40% (or six institutions) admitted that their roles had in fact been affected, albeit in a relatively minor way. Those effects overlap with institutions whose funding was cut

and included not being able to hire staff as needed and a limit put on pay increases. One respondent who replied that they had received the same amount of funding as in previous years, also stated that there was now “considerable emphasis on innovation needed to achieve a move to low carbon, low emissions campus”, indicating more pressure to reduce their carbon footprint. Below is a list of institutional effects of cuts in funding to the FHE sector.

Effects of Cuts in Funding

In order to determine the extent to which departments or teams were affected, participants were given a list of possible responses. Those responses included:

- A reduction in the number of staff in department or team (39 survey participants);
- A reduction in number of job related resources (membership of support organisations, other university resources (thirteen survey participants);
- An inability to purchase sustainable equipment (eleven survey participants) or participate in sustainable projects (five survey participants);
- A freeze or reduction in funding available to attend conferences, workshops, events (twenty-one survey participants);
- A freeze or reduction in funding available to attend continuous professional development (CPD) course, evening classes (twelve survey participants);
- An inability to complete in full an already established sustainable project (seven survey participants);
- A loss of financial savings made as cost-saving exercises had been scrapped (four survey participants);
- An increase in workload (thirty-one survey participants); and
- An increase in overall work related stress (twenty-two survey participants).

None of the survey participants reported a decrease in workload despite a total of eight survey participants reporting having to either take a pay cut, reduce their hours or cut their benefits. Even the fourteen survey participants who answered “No” or “Don’t Know” to their team or department being directly affected admitted to still experiencing some effects. However, the 2010 announcement of a £600 million cut in funding to education and research has been seen as an opportunity for some institutions to examine their sustainable performances and to work on areas where there is scope for improvement. At least 71% of institutions have implemented some sort of sustainable initiative since the cuts were announced. Those initiatives

included switching off equipment and lights when not in use, investing in energy saving equipment, engaging in behavioural change and appointment of a green champion to monitor and reduce energy usage and any waste created. So while the overall impact of the 2010 cuts in funding may have been negative, some institutions regarded those measures of austerity as opportunities to examine how wasteful their behaviour had been and how best to make improvements. For others still, it has strengthened their push for the use of more sustainable equipment across campus (see Figure 4.14). UK FHE institutions have also indicated a more conscientious and innovative approach to their environmental decision-making since the cuts were announced. For a full analysis, see Appendix XI.4.

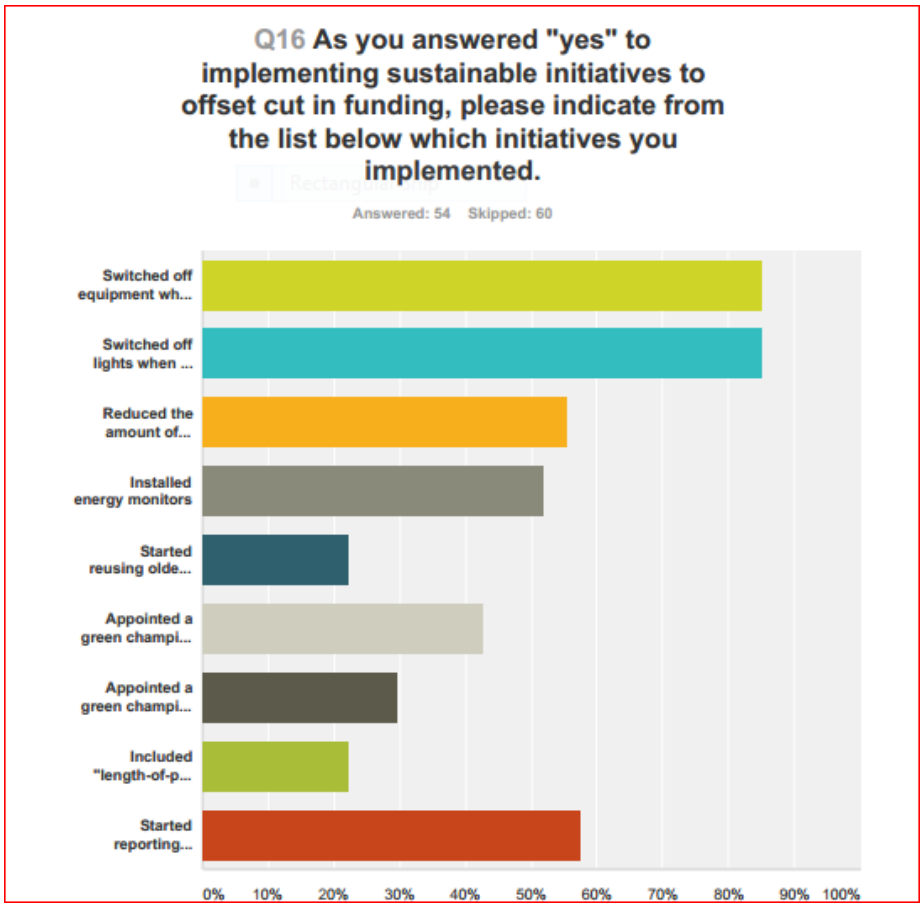


Figure 4.14 Initiatives implemented to offset cuts in funding.

Summary of Cuts in Funding Survey.

This survey clearly indicated that cuts in funding to the sector have affected institutions' ability to implement sustainable ICT initiatives. While a large majority, 71%, indicated using the cuts as a reason to promote sustainable behaviour in their institution, the list of effects is extensive as illustrated in Figure 4.14 .

Summary of outcomes of the four surveys.

Four surveys in total were carried out whose collective results indicated a series of barriers to institutions participating in sustainable ICT projects. Those barriers included cuts in funding, restrictions from budget-holders and decision-makers and managers lacking in a series of resources crucial to the efficient and sustainable running of an institution.

The outcomes of each of the four surveys included in this chapter indicated the following: a mixture of the presence and absence of barriers to implementing sustainable ICT initiatives**.** Many FHE managers showed a strong concern for the environment and a willingness to participate in environmental initiatives while other managers did not. Any unwillingness is due to being overworked and under-resourced and not having the time to engage. Results also indicated a desire from institutions to reach their carbon targets. However, tackling carbon emissions will prove even more difficult if almost half of institutions do not have a staff member accounting for environmental performance (Hogan, 2011b). When a selection of cross-departmental managers are not involved in procuring for greener technologies this is a clear indication of the following possible barriers: poor stakeholder engagement, lacking managers, institutional culture and budget-holders and decision-makers. See appendices XI.1–XI.4 for a more detailed analysis of these surveys.

4.2.5 End of the Scotland Sustainable ICT Carbon and Energy Management Project and The UK SUSTE-TECH Project.

By September 2011 both projects were nearing their end-stages. E-mails were sent to each of the seven Scotland Sustainable ICT Carbon and Energy Management project contacts and sixteen SUSTE-TECH project contacts asking for final data relating to their Green ICT Action Plans. Only eleven institutions (two from Scotland and nine from the rest of the UK) replied with only seven institutions in total providing enough data to be compiled into a case study for their respective institutions. The seven case studies were publicised and at the time of writing his thesis was available on the EAUC's Sustainability Exchange's website (Sustainability Exchange, 2016d). They indicated overall improvement in institutional ICT energy use through the use of greener technologies and the relative simplicity level at which some were implemented.

In accordance with the projects contract with its sponsor, an independent report was written on the SUSTE-TECH project. The company, Curtis and Cartwright, were commissioned to write the report and in December 2011 started interviewing the main stakeholders. By the end of January 2012 the report was completed and had made the following findings.

4.2.6 Independent Report of the SUSTE-TECH project.

The report concluded that issues encountered in the SUSTE-TECH project were primarily due to a lack of commitment from participating institutions. While some institutions made progress, none delivered against their original expectations. The authors of the report, Shreeve and Curtis, also concluded that poor stakeholder engagement and lacking managers were the principal barriers to full participation by participants in the SUSTE-TECH project (Shreeve and Curtis, 2012).

Specific examples of poor stakeholder engagement and lacking managers in the SUSTE-TECH project included:

1. A lack of clarity amongst institutions about what participation entailed. While there was clarity at the start of the project, each institution participated in different ways, causing weakening of the project concept.
2. Confusion regarding coherence or relevance in the SUSTE-TECH project as several green ICT projects (JISC-funded and others) were run simultaneously.
3. Delayed delivery of the SUSTE-TECH project microsite so participants had no website to log onto and retrieve updates on the project, information on greener technologies, workshops, events, conferences etc. and;
4. Year 2's new remit included ambiguous arrangements for delivery (Shreeve and Curtis, 2012).

Other outcomes of the Shreeve and Curtis independent report that demonstrated barriers to participation in ICT projects included:

1. Poor record keeping of ICT assets (Lacking Managers).

These type of data were crucial to establishing a baseline dataset for participants' ICT equipment. Without them demonstration of improved energy use was impossible.

2. The project took longer than expected (Lacking Managers).

Demonstration of real change typically takes three to five years from initial recruitment. Gathering of baseline data can take up to six months, and will often need to be done by a member of the ICT department in addition to their existing role. Having a dedicated staff member is the best approach. Change may need to be managed even after the improvements are made to ensure that the change 'sticks' and that the intended benefits are realised.

3. Documentation of progress avoided (Lacking Managers).

This was symptomatic of a wider lack of investment, appraisal and evaluation.
It also relates to departments not having enough staff and resources to devote to documenting their progress in the project.

4. IT departments being risk averse (Lacking Managers and Poor Stakeholder Engagement).

ICT staff members are typically reluctant to alter critical services, for example tampering with data centres. It is important for ICT/IT managers to have courage when making environmental improvements to ICT operations and to seek expert support when required. Senior management needs to be engaged with green ICT and while there are some quick wins many improvements require behavioural change, which proved difficult to achieve. Senior management engagement and leadership that supports practitioner buy-in is important.

5. Weak Governance (Lacking Managers).

Although a SUSTE-TECH committee was put in place from the start, this turned out to be more of a high-level support group for the project than a steering group. There were no terms of reference to define the level of oversight, monitoring or authority, etc. A 'light touch' governance and operating on 'good faith' was not appropriate for

this size of project. However, the UK SUST-TECH project and the Scotland project were not seen as complete failures, as valuable lessons were learned from their outcomes. The UK SUSTE-TECH project was considered successful in disseminating information and guidance on topics related to green ICT in universities and colleges. It left a valuable green ICT legacy for the EAUC and JISC, having increased awareness of EAUC amongst FHE ICT/IT staff. The SUSTE-TECH project provided up-to-date information for HEFCE, Sustainable Procurement Centre for Excellence (SPCE) and Universities and Colleges Information Systems Association (UCISA) on green ICT.

4.2.6.1 Green ICT Legacy.

Each organisation has benefited from involvement with the project and all are now better equipped with up-to-date knowledge on the subject for progressing their agendas and supporting their constituencies. SUSTE-TECH presented at conferences in Australia and in Ireland to a European-wide audience. This enhanced the networks between the UK, Europe and Australia and showcased what JISC and the EAUC can offer. Benefits to the rest of the UK public sector included SUSTE-TECH's involvement in central and local government discussions and working groups in green ICT. In particular, involvement with the Greening Government ICT initiative within the Cabinet Office was an unexpected success of the project. In fact, in 2012 the EAUC established a Green ICT Community of Practice on the strength of the UK SUSTE-TECH project which is now part of the Sustainability Exchange programme (Sustainability Exchange, 2015).

4.3 The Stage 2 of the Research.

By the start of 2012, the SUSTE-TECH project was complete. Despite the lessons learned and demonstrable benefits of the use of green ICT, it still appeared that a gap in knowledge existed within the sector regarding barriers to participation in green ICT projects. Results of each of the four surveys indicated the same: FHE managers unable to implement greener ICT initiatives due to a series of barriers. On reflection on the outcomes of each of the four surveys and on the outcomes of the Scotland and UK SUSTE-TECH projects, those barriers became increasingly apparent. They expanded from being just cuts in funding to: poor stakeholder engagement; lacking managers: and an institutional culture that does not support

environmental sustainability. On further reflection the researcher decided that there was sufficient evidence that government organisations could be considered weak drivers of the use of greener ICT in FHEs and that budget-holders and decision-makers could not always see the long-term value in purchasing more energy-efficient ICT equipment. Finally, for many FHE managers, greener ICT did not always equate to savings in energy use either on a short- or long-term basis and so for these reasons was pointless in investing in.

While participants in both the Scotland and UK sustainable ICT projects had indicated that insufficient resources caused by cuts in funding was the reason for such poor participation, no in-depth research into this theory or theories regarding the other possible barriers mentioned above had been conducted previously. It was at this stage that the researcher decided to conduct further research into this topic and so the research's conceptual framework was created.

4.3.1 Conceptual Framework of The Stage 2 of the Research.

Definitions and meanings of the term conceptual framework include;

> *"the current version of the researcher's map of the territory being investigated"* (Miles, Huberman and Saldana 2014, p.20),
>
> "*a structure for organising and supporting ideas and a mechanism for systematically arranging abstractions*"; (Weaver-Hart 1988, pp.11–12) and
>
> "*as a feature for providing a theoretical overview of intended research and order within that process*" (Trafford and Leshem 2009, pp.305–316).

In simpler terms, a conceptual framework is best illustrated via the use of a figure that shows the objectives of the research and the stakeholders involved. It typically comes after the research question and sub-questions have been identified but before the research design and fieldwork have begun. It allows for the coherence between empirical observations and conceptual conclusions. (Leshem and Trafford 2007, pp.93–105).

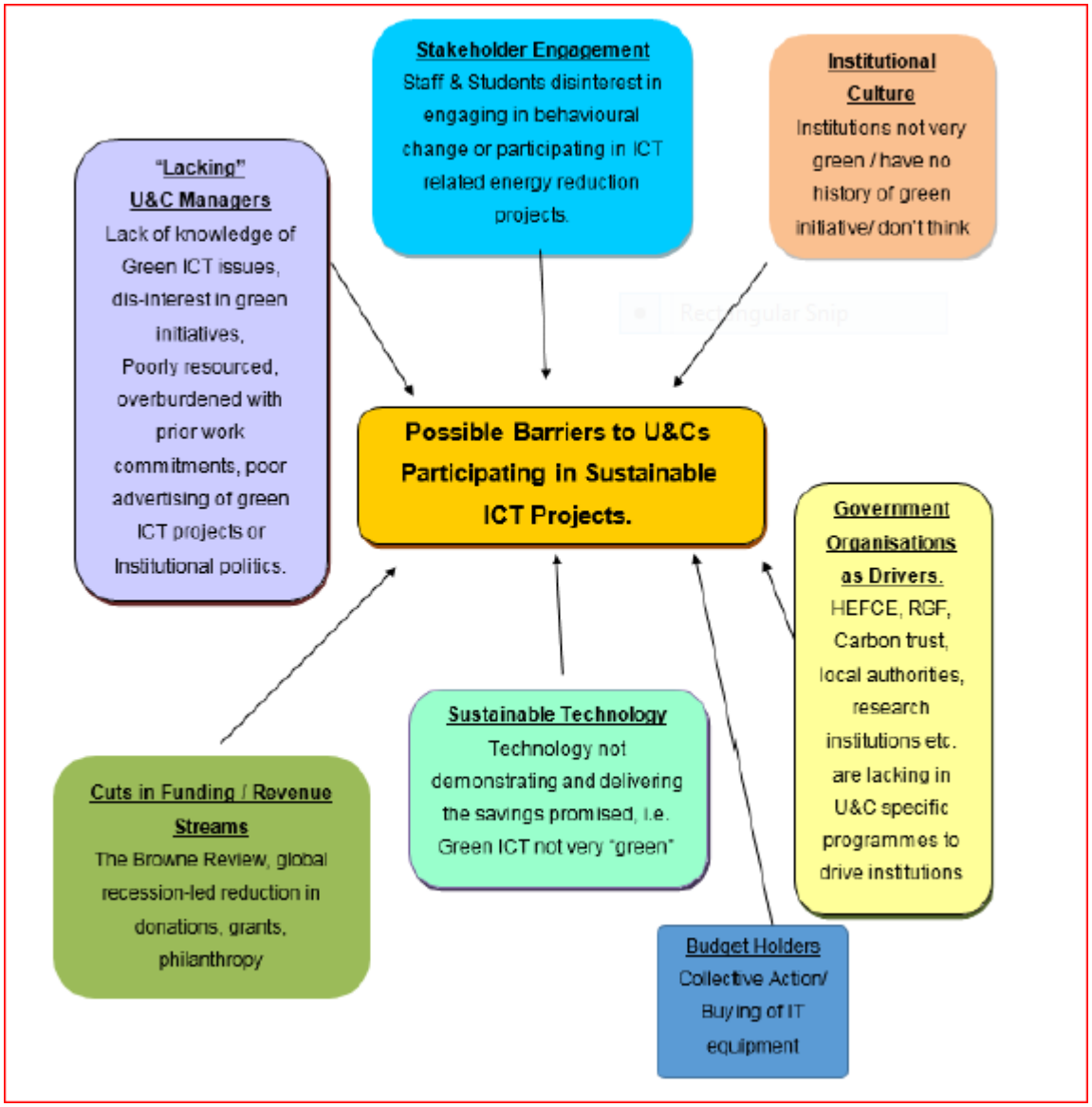


Figure 4.15 The Conceptual Framework for Research into "Identification of Barriers to UK Universities and Colleges Participating in Sustainable ICT Projects"

The conceptual framework for the current investigation is illustrated in Figure 4.15. Contained within the conceptual framework are: lacking university and college managers, poor stakeholder engagement, institutional culture, government organisations as poor/weak drivers, budget-holders' and decision-makers' collective action of buying ICT/IT equipment, sustainable technology and cuts in funding or revenue streams. These barriers stemmed from the results of the preliminary surveys and both the Scotland and UK green ICT case studies. They were, in the researcher's opinion and supported by examples in the literature view, the seven most prominent barriers to FHE's implementing sustainable ICT initiatives.

The following is an explanation of each of the barriers in the conceptual framework of this research:

1. **Lacking Managers.** This principally refers to, but is not exclusive to, ICT managers. It includes sustainable and environmental managers, estates managers, energy managers etc. The term “lacking” refers to managers who are struggling to perform optimally in their roles for various reasons.
2. **Poor Stakeholder Engagement**. In the context of this research, this refers to poor inter-departmental engagement on green ICT issues. It refers to a department requesting information from another but not receiving it, receiving it only in parts or in an untimely fashion. It also refers to departments that consider sustainable ICT issues as being unimportant and not “core business” to their institution, outside of their remit or the responsibility of someone else.
3. **Institutional Culture.** This refers to institutions that have no history of engagement with sustainability issues via either their operations, curriculum or research and may consider them unimportant.
4. **Government Organisations as Weak Drivers**. This refers to government organisations that penalise institutions that do not reach their carbon targets.
5. **Budget-holders and Decision-makers’ Collective Action/ Buying of ICT/IT equipment**. This pertains to procurement departments and senior managers who inhibit the purchase of sustainable ICT equipment for various reasons including not being part of a purchasing framework and/or not supporting staff in their need to purchase greener ICT.
6. **Sustainable Technology.** This occurs when sustainable technology does not produce the cost and carbon saving results it promised and institutions deciding to no longer continue participation in green ICT projects.
7. **Cuts in Funding/Revenue Streams.** This is when institutions can no longer participate as a result of cuts in funding to their institution and/or their department. This includes cuts affecting staff workload, allocated number of hours and salary.

While each of the barriers was conceived based on outcomes of the Scotland and UK SUSTE-TECH projects and the results of the preliminary surveys this research also needed to consider factors/barriers outside of the conceptual framework. Those "outside factors/barriers" are illustrated in Figure 4.16.

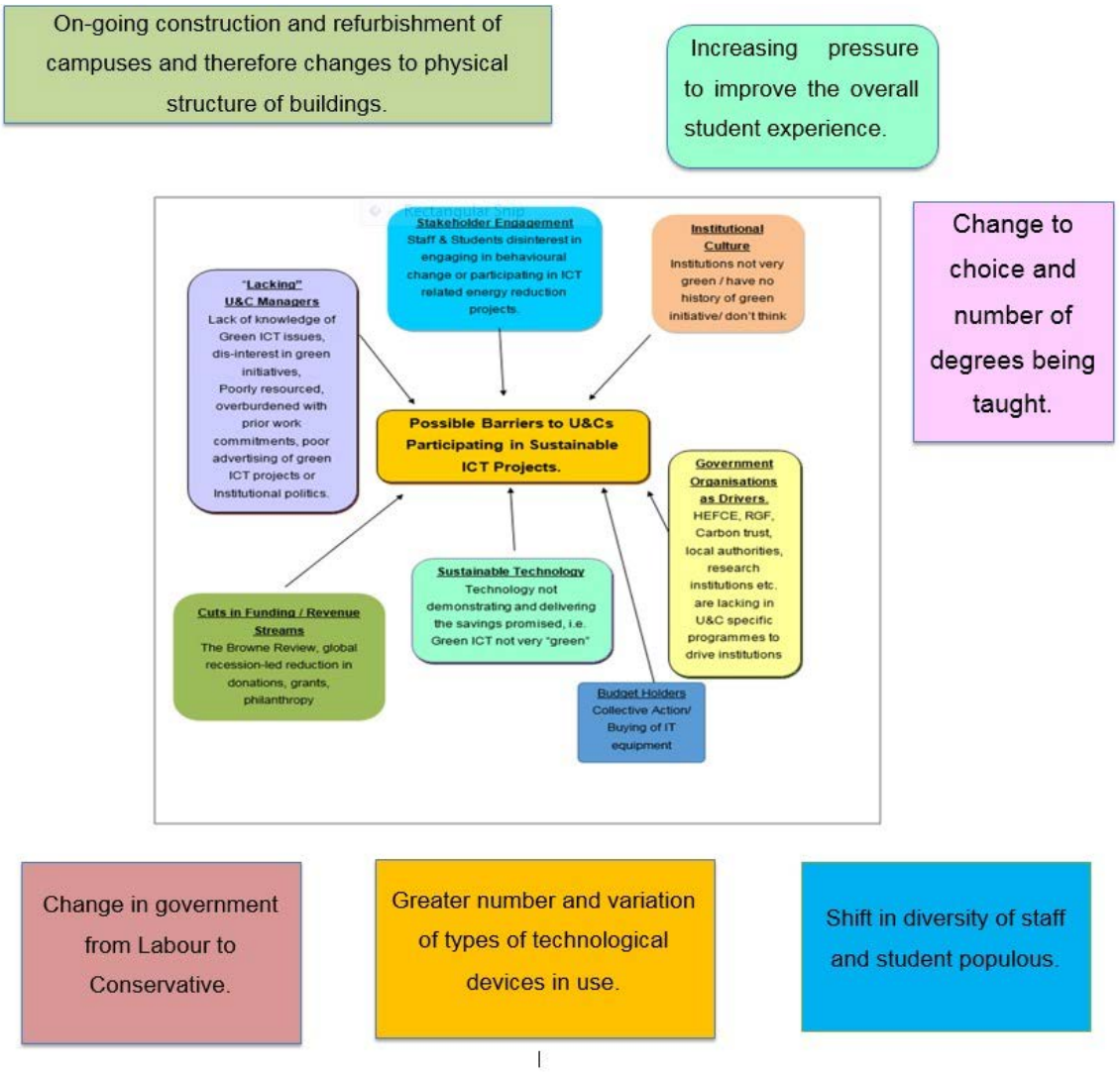


Figure 4.16 Factors/Barriers Outside of the Conceptual Framework.

The "outside factors/barriers" were excluded as the researcher felt that the seven barriers included were the most prevalent based on preliminary research and on the literature review and were therefore the most urgent to tackle. Adding any of the excluded factors would have expanded the remit of the research too broadly and diluted the focus of the researcher.

4.3.2 Analysis of the Scotland Sustainable ICT Carbon and Energy Management Project against the Conceptual Framework.

As further evidence of the existence of the seven barriers, outcomes of the Scotland and UK projects were compared against it. The results of an analysis of both projects are shown in Table 4.1 below and show the barriers each of the seven Scottish and sixteen UK institutions experienced.

Table 4.1 Barriers to Participation Identified in the Scotland and SUSTE-TECH Project participants combined (A–W).

Possible Barrier	Poor/Disjointed Stakeholder Engagement	Institutional Culture	Government Organisations as Drivers	Budget-Holders Collective Action when buying ICT equipment	Sustainable Technology not as green or cost effective as anticipated.	Cuts in Funding and Revenue Streams	Lacking Managers
Inst. A	x					x	x
Inst. B	x						x
Inst. C	x				x	x	x
Inst. D	x				x	x	
Inst. E	x						x
Inst. F	x						
Inst. G.	x						x
Inst. H	x						x
Inst. I	x						x
Inst. J							x
Inst. K	x						x
Inst. L	x						x
Inst. M	x						x
Inst. N	x						x

Possible Barrier	Poor/Disjointed Stakeholder Engagement	Institutional Culture	Government Organisations as Drivers	Budget-Holders Collective Action when buying ICT equipment	Sustainable Technology not as green or cost effective as anticipated.	Cuts in Funding and Revenue Streams	Lacking Managers
Inst. O	**x**						**x**
Inst. P	**x**						**x**
Inst. Q	**x**						**x**
Inst. R	**x**						**x**
Inst. S.							
Inst. T.							
Inst. U.							
Inst. V.							
Inst. W.							
Total Number of Times Barrier Existed	**17**	**0**	**0**	**0**	**2**	**1**	**15**

Outcomes of both projects indicated some or all of the seven barriers, listed in the conceptual framework, could be identified in eighteen of the twenty-three FHE institutions. Five institutions did not experience any barriers to participation in their respective sustainable ICT projects. While they may have experienced a delay in collecting the data, ultimately they completed their SusteIT Tool and submitted their final progress report (Hogan, Jimenez-Bescos and Frame, 2015).

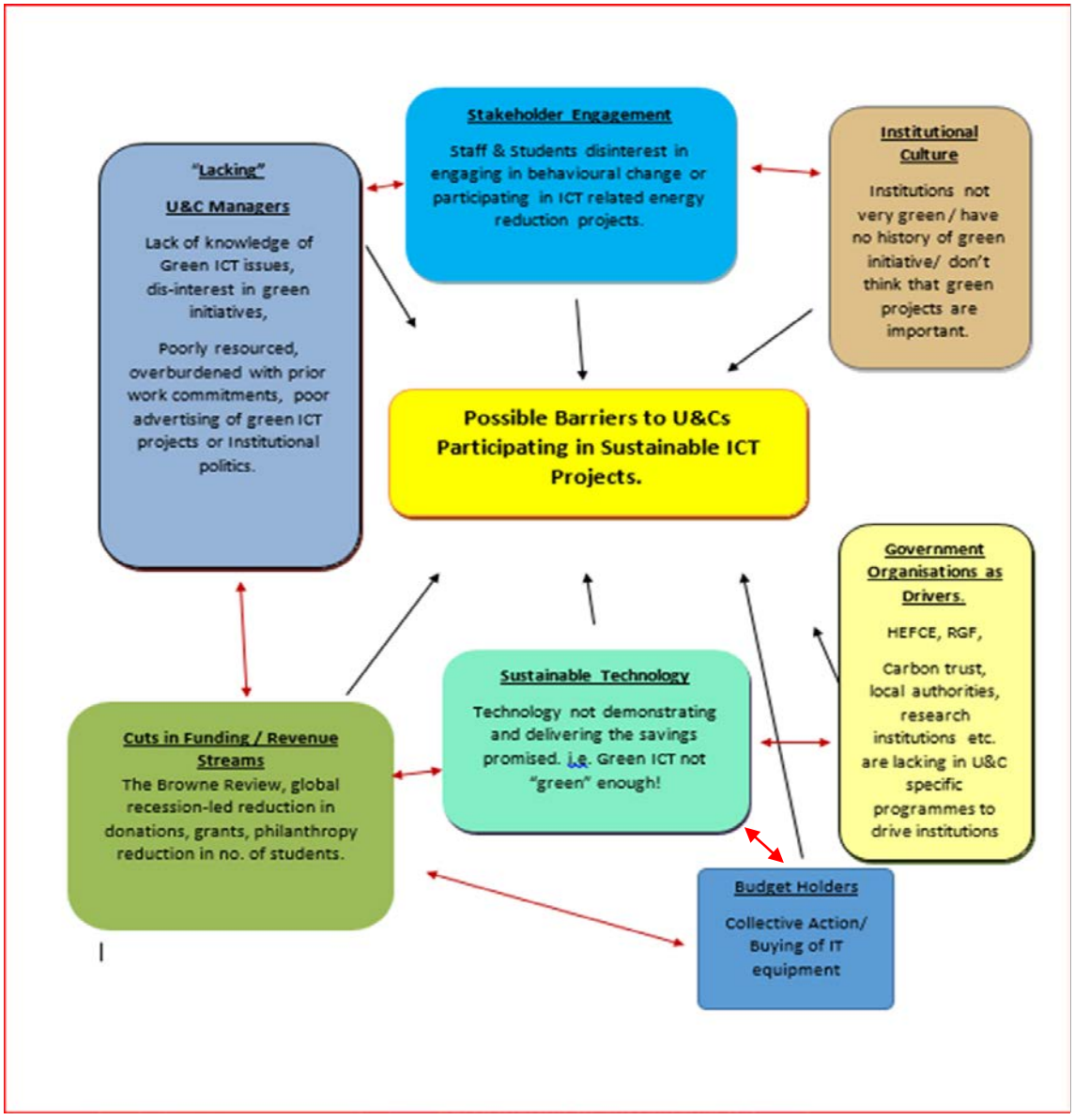
4.3.3 Identification of Barriers in Scotland and UK SUSTE-TECH Projects.

As can be seen from Table 4.1 above, poor/disjointed stakeholder engagement and lacking managers were the two most common of the seven barriers to institutions participating in either of the sustainable ICT projects. With a populace of seventeen and fifteen respectively, these barriers were present in both universities and colleges from both regions in the UK. Only two institutions stated that they could not participate fully because of issues relating to poor green ICT performance and just one institution stated that it was because of cuts in funding. Institutional culture, government organisations as drivers and the collective action of budget-holders and decision-makers were *not* considered to be barriers to participation in sustainable ICT projects in either the Scottish or UK institutions. The only clear disparity in results were five UK institutions, (S–W), which did *not* experience any of the barriers listed. Those five institutions each submitted data relating to their green ICT improvements and each became the subject of a case study. However, looking more closely at each of the barriers, it can be concluded that some underpin one another.

4.3.4 Underpinning Barriers.

Closer examination of each of the barriers and of the responses to the four surveys as part of the Scotland and SUSTE-TECH project, suggests that insufficient funding underpinned each of the barriers and in some cases exacerbated them. Another conclusion is that while poor stakeholder engagement and lacking managers appear to be the principal barriers, the other five can each be considered to fall under the same description. While there is a strong indication that poor participation in sustainable ICT projects is mainly due to poor stakeholder engagement and lacking managers, much of this is also due to insufficient funding and the ripple effects it has on projects within the same institution, sustainable or otherwise. The red arrows in Figure 4.17 indicate which of the barriers appear to underpin one another. For example, the cuts in funding or revenue stream barrier directly affect the action of budget-holders and decision-makers. If budget-holders and decision-makers have their funding cut, they may not be able to refresh their ICT kit with newer, more energy-efficient, greener technology. They may also choose *not* to alleviate cuts in funding *if* greener technology was reputed *not* to be delivering on its promised energy savings. In addition, when there is no government organisation driving an institution to invest in sustainable ICT as part of their carbon reduction targets, this further compounds each as a barrier. Another example is how lacking managers are

often lacking because of the culture at their institutions. An FHE institution with a culture that does not include environmental sustainability is likely to find engagement with stakeholders on greening issues even more difficult. While cultural change in FHE institutions is possible, it can only happen when staff are given adequate funding to hire support staff and pay for training and the correct materials and technology to deliver on a change to culture.



Direct Barrier	
Underpinning Barrier	

Figure 4.17 Underpinning Barriers to UK University and Colleges Participating in Sustainable ICT Projects.

4.4 Summary of Chapter 4.

This chapter reviews the Scotland Sustainable ICT Carbon and Energy Management Project and its UK counterpart, the SUSTE-TECH project. It shows how some institutions have been successful but others have struggled to implement sustainable ICT initiatives. Central to the remainder of this research, this chapter explains how the less than successful outcomes resulted in the researcher realising that a significantly larger gap between what can occur in theory and what happens in reality exists, at least where implementation of greener ICT initiatives is concerned. This gap in knowledge required further enquiry, which resulted in this investigation's principal research question and sub-questions being conceived. To conclude, even after the apparent "failure" of both the Scotland and the UK SUSTE-TECH projects, both produced outcomes of "lessons learned" and a realisation that further research was required to investigate why participation in green ICT projects only occurred at a small number of institutions and at minimal levels. The lessons from the Scotland ICT Carbon and Energy Management Project and the UK SUSTE-TECH project included;

(i) a warning of possible barriers that are likely to arise when embarking on the implementation of sustainable ICT projects in large institutions, but

(ii) when managers are mindful of those barriers, can take preventative measures to avoid the failure of a project and thereby save institutions time and money.

However, by February 2012 the researcher still needed to investigate further and examine more closely, and on a larger scale, the extent to which each of the seven possible barriers affected institutions' ability to implement sustainable ICT initiatives. The most reliable and direct method of gathering a sufficient amount of data at a doctoral level was to conduct two surveys, one for the UK and one for the Irish FHE sector. Circulating a survey to the Irish FHE sector was carried out to ensure a sufficient quantity of comparable data. As Irish FHEs are similar in their operations to those in the UK, they are likely to experience similar barriers and so that experience and the opinions of managers were required. Known as the main research surveys, these surveys directly addressed the possibility that each of the seven barriers existed with their results proving their existence or absence and to what extent.

The researcher also believed that once identified, the barriers could be overcome. This in part was due to the fact that as stated in Chapter 2, section 2.7, “with their depth of expertise, innovative research and societal influence, universities and colleges have been at the forefront of addressing global warming (Eagan et al., 2008, p.4) therefore identification of any barriers to implementation of green ICT initiatives was imperative. The main research surveys, i.e. the UK and Irish surveys were circulated in November 2014 to identify what the barriers were so they could be overcome as soon as possible.

Chapter 5 Part (I): Analysis of UK and Irish Survey Results.

The UK and Irish Surveys: A Quantitative Study.

5.0 Introduction

This chapter reports on the results of the conceptual framework surveys, that were circulated via e-mail to over 215 UK and Irish FHE sector managers, in November of 2014. The UK survey was circulated to the 146 subscribers to the EAUC-London JISCMail mailing list. While the identity of subscribers to this mailing list is confidential, it is likely to have included any remaining SUSTE-TECH and Scottish project participants who were also likely to be subscribers of the EAUC's Green ICT communities of practice mailing list. Respondents to the Irish survey were members of An Taisce's ICT mailing list and comprised of sixty-nine Irish FHE managers. The UK survey achieved a 41% (60/146) response rate and the Irish survey a 23% (16/69) response rate. These response rates averaged out at 35% (76/215) and an analysis of each of the questions responses are included.

The surveys were designed to further investigate and validate the seven possible barriers to universities and colleges participating in sustainable ICT projects, by projecting further investigation within the UK and Irish FHE sector. There were a total of nineteen questions, with seven of them pertaining directly to each of the possible barriers. Each question had a choice of answer options and while most of the options were closed answers, some were open and included comment boxes.

The questions pertaining to the barriers included:

1. When implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged? i.e. were they willing to adjust to changes in job roles, train in the use of greener technologies etc.?
2. Is participating in green ICT projects typical of your institution's culture?
3. Of the government organisations listed (HEFCE, DEFRA, DECC, Salix, Local Authorities, Other Government Funded Organisation) please state how they have affected your institution's participation in green ICT projects (Excellent Driver to Very Poor Driver).
4. Do you feel that green technology delivers on the financial and carbon savings promised by IT companies?
5. Have recent cuts in funding to the educational sector affected your institution's ability to participate in sustainable ICT projects?

6. Assuming your institution is part of a framework (e.g. LUPC) that includes criteria for the purchase of sustainable technology, do you feel you are supported in your choices to purchase more sustainable technology?

7. Do you feel your institution's ICT manager(s) are "lacking" by exhibiting any of the characteristics below?

5. Six of the seven questions offered a “Yes, No or Somewhat” response option with follow-up answer options asking why respondents might have chosen that answer. A detailed analysis, discussion and evaluation of each of the responses are included in Appendix XII.1–XII.4 The surveys were conducted via e-mail (as opposed to face-to-face interviews) and/or via telephone, as it was thought to be the most practical and efficient method of engaging with such a large number of FHE managers within a reasonable time-frame. The survey was created using the online survey support website SurveyMonkey. SurveyMonkey offers an easy-to-use tool for creating surveys that allowed for multiple choice answers and follow-on questions. All survey results were automatically tabled and graphed, making their analyses easy to read. Further analysis could be conducted on a participant-by-participant basis, allowing the researcher to gain a better insight into the overall mindset of an FHE manager. Most importantly, the UK and Irish surveys were conducted to gather quantitative data on each of the seven possible barriers, as the researcher was concerned with gaining objective knowledge on the subject and wanted to use an established and scientific method of enquiry. Results of the surveys would essentially validate, or invalidate, the theory that each of the seven barriers existed and answer the research question (i) what are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives? and to a lesser extent the first sub-question (ii) what are the key implications of those barriers?

A summary of the responses to each of the nineteen questions in both surveys follows;

5.1 Regional Location of UK Institutions.

The UK survey commenced by asking each of the respondents to give the location of their institution within the UK. The locations were divided up into nine regions including Wales and Scotland and outside of the UK and are summarised in Table 5.

Table 5.1 Regional location of UK Institutions.

Region in the UK	Frequency	Valid Percent
London	31	51.7
UK Southwest	1	1.7
UK Southeast	7	11.7
UK Northeast	4	6.7
UK Northwest	0	0
Midlands	8	13.3
Wales	3	5.0
Scotland	1	1.7
Outside the UK	5	8.3
Total	60	100.0

5.1.2 Responses to Regional Location of UK Institutions.

More than half (51.67%) of respondents were from the London area with all other regions except the UK Northwest being represented. This may be due to the researcher being an active member of the London University Environmental Group (LUEG) and therefore well known amongst her cohorts. It may also be because there is a higher concentration of FHE institutions in the London region than anywhere else in the UK (HESA, 2016). Representation from the six other regions UK South East, UK South West, UK North East, and the Midlands may be due to the manager's familiarity with participants since managing the UK SUSTE-TECH and Scottish Sustainable ICT projects. Overall the number of respondents was representative of the general population of FHE managers in the UK whose remit included ICT or environmental or sustainability roles. These results indicated a representative sample of management's experience of barriers when implementing sustainable ICT

projects. A response rate of 43% was reached and lies within the statistical spectrum of the bell curve of reliability, so results are reliable and valid.

5.2 Job Titles of Respondents.

This question was asked in order to clarify what type of managers were participating in the UK survey. Survey respondents were asked to indicate from a selection of nine options their role within their institution. The job titles of respondents are summarised in Table 5.2 below.

Table 5.2 Job titles of respondents to UK survey.

Job Title	Frequency	Valid Percent
ICT/IT Manager	11	18.3
Environmental/Sustainable Manager	15	25.0
Energy Manager	3	5.0
Estates and Facilities Manager	2	3.3
Procurement/Finance Manager	2	3.3
Utilities Manager	1	1.7
Other	26	43.3
Total	60	100.0

5.2.1 Job Titles.

All sixty survey respondents answered this question with 43.33%, or twenty-six choosing the *Other* option. The remainder of replies, 25%, or fifteen respondents, predominantly came from Environmental or Sustainable Managers with just over 18% or eleven replies coming from ICT/IT Managers. 5%, or three, responses came from Energy Managers and just over 3% of replies came from Estates and Facilities and Procurement Managers. Neither Space Managers nor Carbon Managers participated in the survey. Twenty respondents left a comment, two stated they were librarians, seven stated they were an ICT/IT Manager of sorts and four indicated their roles had an environmentally sustainable aspect to them. Respondents who categorised themselves as *Other* managers included a departmental manager, a project and programme manager, a lecturer and a member of the administrative

staff. Results also gave an indication of the broad spectrum of responsibility and variation of job roles that incorporates aspects of environmental sustainability.

5.3 Length of Time in Current Role.

UK respondents were then asked about their length of time in their current role. Respondents were asked to choose from a selection of six options that gave the number of years in their role at their current institution. Answer options were divided into increments of five years starting at zero and ending at thirty. The number of years respondents were in their current role are summarised in Table 5.2

Table 5.3 Number of years respondents were in current role.

Number of Years	Frequency	Valid Percent
0–5 years	33	55.0
6–10 years	15	25.0
11–15 years	4	6.7
16–20 years	4	6.7
21–25 years	2	3.3
26–30 years	2	3.3
Total	60	100.0

5.3.1 Number of Years in Current Role.

All sixty survey respondents replied to this question with the majority 55%, or thirty-three respondents working in the sector for less than five years. The fact that the majority of respondents were in the role for five years or less indicated two things:

1. An indication of FHE managers having limited experience and therefore possibly having less knowledge when identifying and attempting to overcome barriers. Being in a role less than five years may bring with it an overly optimistic approach to implementation of sustainable initiatives with an inability to foresee possible hurdles. Inexperienced staff may have less knowledge of how their university operates or which channels are best to go through to ensure a project's success.
2. Contrary to this evaluation, being in a role for five years or less might indicate a manager who is younger and is therefore likelier to have more energy to

persevere when faced with barriers. It is also likelier they are aware of the latest technology that supports the efficient management of a campus, therefore facilitating greater productivity. Being in a role for five years or less might indicate a workforce that is not experiencing job burn-out or ambivalence as often happens when working in the same role for longer periods of time. This question was asked to gain insight into the level of experience respondents had in relation to implementing sustainable ICT initiatives and would give authenticity to answers. If results indicated that staff were in their roles for a considerable number of years, their input would be likelier to be more reliable and realistic.

However, as replies indicated the majority of respondents had been in their role five years or less, with the number of managers in their role decreasing as the category of years increased, this indicated a younger and possibly less experienced group of managers. Nonetheless, managers being in their role for five years or less does not necessarily indicate an inability to identify and overcome barriers when implementing sustainable ICT initiatives (Garthwaite, 2017; Folkman, 2015). If results had indicated that staff were in their roles for a considerable number of years, responses to the remaining sixteen questions could be considered more credible. Alternatively, older managers might be experiencing career burnout and their responses might be biased against anyone attempting to implement change.

5.4 Number of Years Worked in the University and College Sector.

This question allowed respondents to offer information and knowledge that they may have on their total experience working in FHE sector. It also allowed for the comparison of responses from respondents who may have changed jobs during their careers and allow the researcher to assess the value of their input. The number of years respondents had worked in the university and college sector are summarised in Table 5.4.

Table 5.4 Number of years respondents worked in the UK university and college sector.

Number of Years	Frequency	Valid Percent
0–5 years	20	33.3
6–10 years	14	23.3
11–15 years	13	21.7
16–20 years	4	6.7
21–25 years	5	8.3
26–30 years	4	6.7
Total	60	100.0

5.4.1 Number of Years in the University and College Sector.

All sixty respondents answered this question. Results indicated that as long as they had been working, they remained within the FHE sector. The fact that the majority were in the sector less than five years indicates a younger workforce that typically brings with it energy, idealism and knowledge of the latest in sustainability and ICT (Garthwaite, 2017; Folkman, 2015). However, as the minority of survey respondents had been in the FHE sector almost thirty years, they are likely to bring to the survey a wealth of experience. They are likely to have faced one or more of the barriers at some point in their careers and possibly in other roles within the FHE sector. Alternatively, it might also be that after more than twenty years of working in the FHE sector they consider all minor issues to be barriers and are far less likely to participate in anything new as they have "seen it all before". They may have become despondent and ambivalent in their roles and might be reluctant to engage with or are suspicious of change. This in itself may be perceived as a barrier.

5.4.2 UK Survey Respondents Background.

Responses indicated that the majority of managers who took part in the survey were from London institutions with the remainder of the UK represented in varying amounts. Those managers were predominantly ICT/IT managers, environmental and sustainability managers and Other managers. The majority of managers were in their roles five years or less and had worked in the FHE sector during that time

with the remainder having worked in the sector up to thirty years. Establishing background information on the respondents added not only credibility and value in identifying the seven barriers, it allowed the researcher to compare and contrast responses based on those backgrounds. The follow-on fifteen questions were specific to each of the seven barriers and aimed at gathering critical information and data on each barrier.

5.5 Stakeholder Engagement.

The first of the seven "barrier-related" questions pertained to stakeholder engagement and offered three answer choices. The question asked "when implementing 'greener ICT' in your institution, were stakeholders (staff and students, other organisations etc.) engaged, i.e. willing to adjust to changes in job roles, train in the use of greener technologies etc.?"

The results are summarised in Table 5.5.

Table 5.5 Stakeholder Engagement.

Engaged or Disengaged.	Frequency	Valid Percent
Yes	18	36.7
No	6	12.2
Neither engaged nor disengaged	25	51.0
Total	49	100.0

5.5.1 Stakeholder Engagement in UK Institutions.

Overall results indicated the majority of respondents 87.75% (forty-three) were engaged on some level answering either Engaged or Neither Engaged nor Disengaged in implementing greener ICT initiatives in their institution. To explore further, respondents who answered *Yes* to Stakeholder Engagement were then asked to choose from answer options that best described why they answered *Yes*. Reponses indicated it was because stakeholders were informed of the decision and felt included in the decision-making process. This was closely followed by older technologies starting to slow down/fail, and newer, faster technologies being welcomed into the workplace. Stakeholders also welcomed initiatives that reduced energy bills and carbon emissions. Respondents could choose more than one answer option and each of them did, indicating there is no preferred or more

appropriate singular method of engaging with stakeholders when switching to the use of more sustainable technologies (see Appendix XII.7).

Results indicated that for respondents who answered *No* to stakeholder engagement, there was less of a disinterest in being sustainable or thinking that implementing green ICT is disruptive, and more that behavioural change required effort that does not necessarily result in cost or carbon savings. Any resistance or ambivalence towards the implementation of greener ICT was due to staff not being informed of the changes to the use of greener technologies. However, results also indicated that providing there is a gradual and minimal disruption to services, there will be minimal protest. For others, they simply did not have an opinion on the switch to using sustainable technology.

The responses also indicated an overall trend towards the positive uptake of greener technologies with the majority of staff being either positive or ambivalent toward greener ICT and happy to participate in, or at least not inhibit, its implementation. Therefore, engaging with stakeholders might not be considered a significant barrier to participation in sustainable ICT projects. However, stakeholder engagement can be considered a barrier in some institutions as results indicated that the environmental and financial benefits of using green ICT are not believed in by everyone. Stakeholders are reluctant to start utilising greener technologies when they are required to deviate from what is familiar. A detailed breakdown of the results of each of these this questions is given in Appendix XII.5–XII.8.

5.6 Culture of Green ICT.

Survey respondents were asked if participating in green ICT projects was typical of their institutions' culture. This was to establish if institutional culture was proving to be a barrier to participation in sustainable ICT projects or not. Respondents were asked to choose from three answer options and the results of this question are summarised in Table 5.6.

Table 5.6 Culture of Green ICT in UK Institutions.

Responses to Culture of Green ICT in UK Institutions	Frequency	Valid Percent
Yes	21	51.2
No	11	26.8
Neither typical nor non-typical.	9	22.0
Total	41	100.0

5.6.1 Culture of Green ICT in UK Institutions.

These results show that green ICT projects are typical of the majority of institutions' culture, indicating a capture of the hearts and minds of stakeholders in favour of sustainable ICT initiatives. However, for some institutions green ICT is not part of their culture and for others it neither is nor is not. When asked why they responded *Yes* to having a culture of green ICT in their institutions', replies included comments relating to managers being adequately resourced, being passionate about their roles and who engage with staff and students, contributing significantly to the successful outcomes of green ICT projects. They also showed support of the engagement of hearts and minds and referenced that switching to greener ICT was an attempt to reduce their institutions' carbon footprint. However, some of the comments were not as supportive. One respondent stated that it was as an unintended result of the switch to newer technology where their previous equipment had been underperforming. Another comment stated that that switching to greener technology was driven by the "student experience" and their expectation of ICT to work continuously and were not concerned about the energy implications. Regardless of the reasons for the switch to greener technologies, it is clear that the culture of engaging with technology to make a campus more sustainable is crucial to overall environmental performance and, counteractively, having a culture that is not supportive will inevitably prove to be a barrier and a limiting factor.

'No' responses to this question indicated that for the most part, employees are not overly concerned with the workings of the university so long as it does not severely impact their ability to work. Respondents also stated that they do not always have "buyin" from senior managers, indicating the importance of support from senior management to the success of projects, green ICT or otherwise. It also proved how

detrimental a barrier to ICT projects lacking managers can be. Implementation of sustainable ICT projects must be carefully managed with this in mind. Unsurprisingly, overall results were mixed with some institutions stating that green ICT is part of their culture and others indicating it is not. For most institutions their culture of lacking managers was proving to be as much of a barrier as was proving that green ICT is a cost saver. A detailed breakdown of the results of this question is given in Appendix XII.9– XII.11.

5.7 Government Organisations as Drivers.

Several government organisations offer assistance with reducing carbon emission but offer different incentives and therefore act as drivers in different ways. Those organisations are HEFCE, DEFRA, Salix, Local Authorities and Other government organisations. Survey respondents were asked to state how each of the government organisations had affected their institutions' participation in green ICT projects from a selection of answer options: Excellent Driver, Good Driver, Neither a Good Nor a Bad Driver, Poor Driver or Very Poor Driver. Each answer option was to be applied to how they regarded each and responses for each organisation are summarised in the series of tables in Appendix XII.12–XII.17.

5.7.1 Government Organisations as Drivers in UK Institutions.

Just thirty-seven respondents answered this question and replies were mixed with each of the government organisations predominantly being reported as being "*neither a good nor a bad driver*". Overall, government organisations have proven not to be a barrier but not much of a driver either. Most institutions are concerned about their overall carbon targets and typically tackle their infrastructure which includes inefficient boilers, clogged pipework and poor insulation, thereby achieving quick wins. ICT energy consumption is not always at the top of an FHE institutions list of areas to tackle and there is no additional financial penalty for institutions if ICT-related carbon targets are not reached. In short, institutions' experience with government organisations as drivers for implementing greener ICT varies across the UK, but for the most part is neither good nor bad. See Appendix XII.12–XII.17 for a detailed breakdown of the results of this question.

5.8 Green Technology Delivering on Financial and Carbon Savings in UK Institutions.

Respondents were asked “do you feel that green technology delivers on the financial and carbon savings promised by IT companies?”, in the hope of establishing whether sustainable technology had a good reputation within the sector for delivering on cost and carbon savings, as promised by ICT companies. Preliminary research had shown that in some instances, green ICT demonstrated clear cost and carbon savings but elsewhere no real improvements were made. This question was included in the survey to further enquire why this may be the case. Respondents had the option of answering *Yes, No* or *Somewhat* to the questions and the results of that question are summarised in Table 5.7.

Table 5.7 Green Technology Delivering on Financial and Carbon Savings.

Green Technology Delivering on Financial and Carbon Savings	Frequency	Valid Percent
Yes	6	16.2
No	6	16.2
Somewhat	25	67.6
Total	37	100.0

5.8.1 Green Technology Delivering on Financial and Carbon Savings in UK Institutions.

Results were similar for *Yes* and *No* responses, but significantly larger for the *Somewhat* responses. The comments provided evidence of various institutional issues, such as the lack of collaboration between departments and the trust and distrust of ICT managers regarding the ability of greener technologies to deliver on cost and carbon savings. This mixture of responses is a reflection of both the positive and negative experiences of managers, when tasked with making cost and carbon savings through the use of greener technology. This is therefore a clear indication of the reputation of green ICT *not* delivering on cost and carbon savings and therefore proving to be a possible barrier and limiting factor. Respondents were then

asked to explain why they answered either *Yes* or *Somewhat* to this question. Answer options included twenty-three different types of greener ICT initiatives and respondents were invited to choose more than one (see Appendix XII.19–XII.20 for full list and their scores). Survey respondents indicated that switching to MFDs was by far the most widely implemented green ICT initiative in UK institutions, followed by double-sided printing and copying and virtualisation of servers. Each of the green ICT initiatives listed were implemented, with most of the institutions implementing more than one initiative. This is likely to have been done in an attempt to have a more holistic, greener ICT system. In total 168 green-ICT answer options were chosen, with thin client technology being the most scarcely implemented one.

The majority of '*No'* respondents 50% (five), stated that the purchase costs far exceeding any savings made as being the reason they did not purchase green ICT, followed by 30% (three) indicating that technology was out of date by the time a return on investment was made. Finally 20% (two) indicated they were unable to see a reduction in energy cost as a result of using greener technologies. Overall, the table of results indicated that each of the options were implemented at some point but none to a significant degree. This is a clear indication that the reputation of green ICT may be considered a barrier. In addition an overwhelming majority stated that green technology failed to deliver on the financial and carbon savings promised by IT companies. Comments left regarding this question also indicated a lack of confidence in greener technologies delivering real financial and carbon savings. A few respondents stated that many financial savings were exaggerated and the speed at which technology advances, was another issue. One comment included some green initiatives being underplayed, but most responses referred to many of the green ICT companies making promises based on best case scenarios. None of the respondents stated that green ICT had delivered substantial savings. Details of the responses given to this question are summarised in Appendix XII.18–XII.21.

5.9 Cuts in Funding

Survey respondents were also asked if they thought cuts in funding to the educational sector affected their institutions' ability to participate in sustainable ICT projects. Responses are summarised in Table 5.8.

Table 5.8 Responses to Cuts in Funding Affecting Institutions' Ability to Participate in Sustainable ICT projects.

Responses to cuts in funding affecting institutions' ability to participate in sustainable ICT projects.	Frequency	Valid Percent
Yes	10	27.0
No	17	45.9
Somewhat	10	27.0
Total	37	100.0

5.9.1 Cuts in Funding in UK Institutions.

As the percentage response rate for *Yes* and *Somewhat* answers are the same, this indicates that cuts in funding may be considered a barrier to institutions participating in sustainable ICT projects. Furthermore, when combining both sets of responses, more than half of institutions stated that cuts in funding *was* a barrier. If the *Somewhat* answers are considered to be an almost *Yes* answer, this would bring the *Yes* responses up to 40%. However, this is still fewer than the 45% of respondents that answered *No*, indicating it was not a barrier. Contrary to these results, a separate survey conducted in 2012 (Hogan, 2012), indicated that institutions were affected by cuts in funding in a variety of ways (see Chapter 4). Results of that survey indicated that seventy-two institutions (80% of survey respondents) had had been affected, albeit to varying degrees. Even respondents who replied that they did not know if their funding had been cut or not admitted that their roles had been affected, albeit relatively minimally. This concludes that cuts in funding *can* be considered a barrier to institutions participating in sustainable ICT projects. For a more detailed analysis of the responses to this question, see Appendix XII.21.

5.10 Purchasing Frameworks.

Respondents were then asked if their institution was part of a framework (e.g. LUPC) that included criteria for the purchase of sustainable technology, and did they subsequently feel supported in their choices to purchase more sustainable technology. Responses would identify whether budget-holders and decision-makers i.e. procurement staff were proving to be a barrier or not. The survey also examined the influence of purchasing frameworks as a barrier to participation in sustainable ICT projects. Responses to the question are summarised in the Table 5.9. and a more detailed analysis of the responses to this question is given in Appendix XII.22.

Table 5.9 Membership of Purchasing Framework and Support for Sustainable Technology?

Support in Purchasing Green ICT	Frequency	Valid Percent
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT.	15	42.9
Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT.	8	22.9
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT.	2	5.7
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT.	0	0
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	4	11.4
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	6	17.1
Total	35	100.0

5.10.1 Purchasing Frameworks in UK Institutions.

Results in Table 5.9 give a clear indication that purchasing frameworks may be a barrier when trying to implement greener technologies. They also gives an indication of how budget-holders and decision-makers in some institutions have incorporated sustainability into their purchasing operations and/or some purchasing managers are forward-thinking when it comes to cost savings. Results indicated that each manager who participated in the survey was somewhat aware of being part of a framework but was not necessarily making the best use of it. While the results were mixed, it is clear that the majority of institutions have a framework of sorts in place that supports staff wishing to purchase more sustainable technologies. However, the combination of results of those who indicated *not* feeling supported is less than those who indicated feeling supported. Nobody who was *not* part of a framework stated that they also felt supported, indicating that having a framework in place is crucial to purchasing greener ICT and that *not* having one may be considered a barrier to participation in a sustainable ICT project.

5.11 Lacking Managers.

Survey respondents were asked about the performance of their ICT managers and if they felt their managers were “lacking" by exhibiting any of a series of seven characteristics. It was hoped that responses to this question would identify if underperforming ICT/IT managers were responsible for poor participation in sustainable ICT projects. Responses to that question are summarised in Table 5.10 and a more detailed analysis of responses to this question is given in Appendix XII.23.

Table 5.10 Characteristics of Lacking Managers in UK Institutions.

Characteristics of Lacking Managers	Frequency	Valid Percent
Poor knowledge of green ICT issues	10	12.0
Disinterest in green ICT initiatives	12	14.5
Disinterest in "outside" green ICT projects (i.e. participating not requested from senior management)	7	8.4
Is negatively influenced by institutional politics	11	13.3

Is under-resourced in terms of funding for new technology	10	12.0
Is under-resourced in terms of allocation of support staff	11	13.3
Is under-resourced in terms of allowances for staff training, upskilling, etc.	10	12.0
None of the above	12	14.5
Total	83	100.0

5.11.1 Lacking Managers in UK Institutions.

There is a mixture of reasons why ICT/IT managers are unable to participate in green ICT projects. However, there are also several institutions that have ICT/IT managers who are not lacking in any of the characteristics given. This indicates that FHE ICT/IT managers' ability to do their job effectively varies, and what may be considered a significant barrier in one institution may not exist in another.

5.12 Overall Analysis of Responses to UK Survey.

Results indicate that barriers to participation in sustainable ICT projects exist in FHE institutions across the UK and those barriers exist in varying amounts as evidenced by the quantitative and qualitative data included in the UK survey. Results also indicate that there is a variety of reasons for the presence (or absence) of each of those barriers. While many are outside of the control of day-to-day managers, they can each be readily overcome via simple but effective changes. Those changes include a renewed approach to environmental sustainability by senior management and effective communication on the benefits of the use of more sustainable technology to all staff. However, there was just as much evidence to suggest that the barriers *do not* exist. Equally as many survey participants replied that they did not experience barriers. For example, eighteen respondents indicated stakeholders at their institutions were engaged in sustainable ICT projects versus six stating they were not engaged; twenty-one respondents indicated a culture of green ICT existed at their institution versus eleven stating that it did not; government organisations were considered excellent and very good drivers almost as much as they were considered to be poor or very poor drivers; equal numbers of respondents believed green technology delivered in cost and carbon saving as did not believe; and

seventeen respondents thought that cuts in funding had not affected their institutions' ability to participate in sustainable ICT projects as oppose to ten who thought that it had. Finally twenty-one respondents indicated being supported in their decision to purchase greener technologies as opposed to fourteen who indicated no support. Results indicated that barriers to implementing sustainable ICT initiatives exist in most UK FHE institutions, but to varying degrees. (see Appendix XII.1–XII.23 for more detailed analysis).

5.13 The Irish Survey.

A similar version of the UK survey was circulated to managers in the Irish FHE sector to establish if the same barriers existed and if they existed to the same extent. Rather than establish what part of the country they worked in, survey respondents were asked to state the name of the organisation for which they worked.

Fifteen organisations in total were represented; six FHEs, five government organisations and three private ICT consultancies. One respondent chose not to give the name of the organisation they worked for. Those organisations included Georgia Tech Ireland, the Environmental Protection Agency (EPA), the Galway Mayo Institute of Technology (GMIT), the Royal College of Physicians Ireland (RCPI), Smartbay Ireland, Waterford Institute of Technology (WIT), St. Patrick's College, An Chéim, HEAnet, An Taisce, the National College of Art and Design (NCAD), Quality and Qualifications Ireland, Information Technology Consultancy (ITC), and the Institute of Technology Tallaght (IT Tallaght). 40% of survey respondents were from Irish FHEs and more than 46% worked in government organisations with 13% of respondents coming from the private sector. Results were divided relatively evenly between Irish FHEs and Irish government organisations and are not as homogenous as results of the UK survey whose respondents were from FHE institutions only. The researcher chose not to omit responses from Irish government organisations or the private sector as their similarity in operations offered valuable insight into possible barriers within the Irish FHE sector when implementing sustainable ICT initiatives (see Appendix XII.24 for more details)

Survey respondents were asked to indicate from a selection of nine options their role within their institution. The majority of respondents were ICT/IT managers with Other managers, Estates and Facilities and Procurement and Finance Managers also responding to a lesser extent. Environmental/Sustainability Managers, Energy Managers, Space Managers, Carbon or Utility Managers participated in the Irish

survey. Similarly to the UK survey, this question was asked in order to clarify what type of managers were participating in the survey. See Appendix XII.25 for more details.

5.13.1 Length of Time in Current Role.

Irish respondents were also asked about the length of time in their current role. Respondents were asked to choose from a selection of six options, indicating the number of years in their role at their current institution. Answer options were divided into increments of five years starting at zero and ending at thirty. There is an even distribution of responses from the first three categories of years, indicating the length of time managers worked in the sector. Only one manager indicated having worked in the sector for between sixteen and twenty years. See Appendix XII.26 for details.

5.13.2 Length of Time in the Irish FHE Sector.

When asked about the approximate number of years spent working in the university and college sector, the majority of survey respondents replied between zero and five years, with those working in the sector between six and ten and eleven and fifteen years reaching almost 20%. Just one participant worked in the sector between sixteen and twenty years, another twenty-one to twenty-five years, and another respondent worked between twenty-five and thirty years. See Appendix XII.27 for details.

5.13.3 Irish Survey Respondents Background.

Results indicated a relatively young workforce with 37.5% (six) of respondents being relatively new to the sector. This is typical of the ICT or IT workforce. As technology is constantly changing, this sector is often filled by recent graduates who possess up-to-date knowledge regarding recent developments in technology. Results indicate a mixture of both youth and inexperience. However, that may also be accompanied by higher energy levels than those in the middle of their working careers who may have gained a considerable amount of experience. Finally, those in the sector for up to thirty years are likely to have witnessed considerable change over the years and be able to offer real insight into why projects succeed or fail. All

tables of results for each of the questions pertaining to the Irish survey are detailed in Appendix XII.27.

5.14 Stakeholder Engagement.

The Irish survey included the same question pertaining to stakeholder engagement and offered the same three answer options. Almost 44% of respondents stated that staff and students at their institution were engaged and 12.5% stated they were not. This indicated that stakeholder engagement *is* a barrier but only in minimal amounts. None of the survey respondents stated that they had *not* tried to implement greener ICT in their institution, indicating that green ICT is widespread in FHEs, government organisations and the private sector in the Republic of Ireland. For the majority of Irish institutions, stakeholders were willing to adapt to changes in their roles in an effort to reduce carbon emissions and running costs. It also showed that each of the Irish FHE and government organisations have implemented the use of greener technologies, on some level. Stakeholders were engaged because they were informed of the switch to greener technology and felt included in the decision-making process. Others stated it was because their institutions' older technologies were starting to slow down or fail, so stakeholders welcomed newer, faster ICT equipment. More respondents stated it was because stakeholders supported any initiative that reduced energy bills and carbon emissions. However, less than 23% stated that their decision to become engaged was due to concern for the environment. This is typical of ICT/IT managers responses as their primary responsibility is to provide ICT/IT services and to ensure computer labs, servers and AV equipment are setup correctly and are in working order. ICT energy demand and/or their environmental footprint is secondary to their remit.

Overall, these results indicate a general attitude of ambivalence towards the uptake of green ICT by Irish FHEs and managers of government and privately owned organisations. As long as disruption to services is minimal and any new technology being installed works, stakeholders will be engaged. Managers at Irish FHEs, government and privately owned organisations are not fully engaged with green ICT, only at a minimal level. This low level of engagement indicates that managers at Irish FHE, government and privately owned organisations believe in the cost and carbon savings that sustainable technologies promise to deliver on. It also indicates that stakeholders are willing to engage in behavioural change to the betterment of their institution, but do not necessarily enjoy it. For a full breakdown and analysis of the responses to this question, see Appendix XII.28–XII.31.

5.15 Culture of Green ICT.

When asked if participating in green ICT projects was typical of their institutions' culture, almost 43% (six) stated that it was, more than 21% (three) stated it was not and more than 35% (four) stated that it was neither typical nor non-typical. This larger percentage of *Yes* responses combined with an almost equally large percentage of *Neither Engaged nor Disengaged* responses, indicates that participating in green ICT projects was typical of the culture of more than 78% of Irish institutions. Of the survey respondents who answered '*Yes'* to Green ICT being part of their institutions culture, 80% stated that it was due to having very innovative and proactive senior managers who encouraged participation in sustainable projects, green ICT or otherwise. The remaining 20% stated that it was because their institution was a leader in ICT research with strong links to other research organisations, so participating in a green ICT project was normal. This shows that when staff are passionate, forward-thinking and adequately resourced, barriers are easily overcome. For those who answered *No* to green ICT being part of their institutions culture, each of them stated it was because their institutions' senior managers were not interested in participating in sustainable projects, green ICT or otherwise. No further comments were left regarding this question. Two responses indicated lacking managers were a barrier to participation in sustainable ICT projects. Four respondents left comments indicating that a selection of green ICT initiatives are occasionally adopted depending on the availability, resources and passion of staff managing the project. It also highlighted the fact that sustainability is not the core business of organisations in the Republic of Ireland and is therefore not always a priority. For a full breakdown of the analysis of the responses to this question, see Appendix XII.32–XII.34.

5.16 Government Organisations as Drivers.

Respondents were asked to grade from a list of eight government organisations and one Other organisation how they affected their institutions' ability to participate in green ICT projects. This question was asked to establish if any of the Irish organisations acted as drivers for change and if they also offered support when participating in sustainable ICT projects. Respondents were given a choice of five answer options: Excellent Driver, Good Driver, Neither a Good nor Bad Driver, Poor Driver or a Very Poor Driver.

Overall the results were mixed, indicating a variation in each of the institutions when dealing with each of the government organisations. Only the Environmental Protection Agency (EPA) and one Non-Governmental Organisation were indicated as being excellent drivers. Only Local Authorities and the Office of Government of Procurement were listed as being very poor drivers.

Examining and summarising the results from a broader perspective, each of the organisations were predominantly considered to be a “middle-spectrum” answer option, indicating it was considered a good, neither good nor bad and/or a poor driver. It can be evaluated that the mixed set of results are due to each individual survey participant having different experiences dealing with each of the organisations. Overall there are no government organisations in the Republic of Ireland that act as significant drivers for sustainable ICT projects in the same manner that JISC was a driver for greener ICT in UK FHEs. For a full breakdown of the analysis of the responses to this question, see Appendix XII.35.

5.17 Green Technology Delivering on Financial and Carbon Savings.

When asked if they felt that green technology delivered on the financial and carbon savings promised by IT companies, almost 60% of survey respondents stated that they somewhat did, almost 17% (two) answered *Yes* and 25% (three) answered *No.* Overall the response was positive towards the use of green ICT as regards being a cost and carbon saver. Combining the *Yes* and *Somewhat* responses together, the overall response rate is 75%, a significant majority in favour of the use of green ICT. Only one person left a comment, but it did not directly pertain to the benefits of the use of green ICT (See Appendix XII.36). In order to gain a better understanding of the extent to which institutions implemented greener technologies, a follow-on question asked respondents to choose from a list of green ICT initiatives implemented at their institution and respondents were invited to choose more than one where applicable. Eight respondents answered this question with eight choosing to skip it. For respondents who indicated that green technology delivers on financial and carbon savings, results were mixed, with cloud-based technologies (virtualisation of servers, shared services and cloud computing) proving to be the most widely implemented initiative. For easier quick wins, printing and copying double-sided by default and video conferencing were common. These two technologies facilitated savings of paper and time. Any technology that allows for multiple savings is likely to prove popular and this was supported in the single

comment that was left for this question. The move to virtualisation of servers, shared services and cloud computing proved to be the most popular, indicating a move to the greater and more confident use of such technologies. Their popularity is often due to the fact that the move results in less work for the technicians as the responsibility is placed on large organisations such as Amazon, Google or Microsoft. Another outcome was the uptake of a technology that allows for the saving of time and space with relative ease, namely video conferencing and double-sided printing and copying. As both technologies come as standard in newer devices or are a free service (SKYPE, Viber) and allow for a more convenient work-life balance, this makes their uptake more likely (See Appendix XII.37).

Of the Irish survey respondents who replied *No* to green ICT delivering on the financial and carbon savings promised by IT companies, 100% stated it was because the purchase costs far exceeded any savings made. 33% stated it was also because by the time the return on investment was realised, the technology was out of date. None of the survey respondents stated that it was due to them not being able to see a reduction in energy costs. Respondents were invited to give more than one answer option and overall results indicated that the initial purchase cost of sustainbale technology is not cost-effective when compared to eventual savings made. The general consensus within the FHE sector is that as soon as a more sustainable piece of technology is purchased and implemented, a more advanced and more sustainable alternative is released on the market shortly thereafter. This sentiment was also evidenced in the UK survey (See Appendix XII.38).

5.18 Cuts in Funding.

When asked if recent cuts in funding to the educational sector affected their institutions' ability to participate in sustainable ICT projects, respondent's replied both *Yes* and *No* in equal measures of 45% (five). Just over 9% (one) stated that it had somewhat affected their institutions. Eleven respondents answered this question, five chose to skip the question and just one respondent left a comment. The results are surprising as the survey was circulated after one of the worst recessions in Ireland in recent years where the public sector was particularly affected buy budget cuts. The *No* answers indicated that respondents had not participated or were not participating in sustainable ICT projects but as there was no follow-on question asking respondents to explain their replies, there is an element of uncertainty. The single comment that was given stated that "massive cuts have

removed any possibility of reviewing these types of technologies". For a more detailed analysis of the responses to this question, see Appendix XII.39.

5.19 Purchasing Frameworks.

Overall the outcomes show that despite being part of a purchasing framework, budget-holders and decision-makers may still experience a lack of support. This further indicated two other barriers i.e. lacking managers and poor stakeholder engagement. Similarly, not being part of a framework does not necessarily equate to lacking management. Support to purchase sustainable technology may still be in place, indicating that passionate, well-resourced staff and good stakeholder engagement can overcome barriers of *not* having a framework in place. For a more detailed analysis of the responses to this question, see Appendix XII.40.

5.20 Lacking Managers.

None of the participants indicated that poor knowledge of green ICT issues was a barrier. 12% (three) indicated a disinterest in green ICT initiatives with more than 8% (two) stating a disinterest in "outside" green ICT projects (i.e. participating in ICT projects not requested by senior management). 12% (three) were negatively influenced by institutional politics. 24% (six) were under-resourced in terms of funding for new technology, 16% (four) were under-resourced in terms of allocation of support staff and the same amount were under resourced in terms of allowances for staff training and upskilling. Just three respondents (12%) answered that managers in their institutions were *not* lacking any of the listed ways and none of the survey respondents left a comment regarding this question. The hybrid of responses with little or no funding for new technologies was the greatest issue for managers, followed by being under-resourced for upskilling, training and hiring support staff. This indicates not only the barrier of "lacking manager" but also the barrier of cuts in funding. Other managerial issues underpinning lacking characteristics included institutional politics and disinterest in green ICT issues. Overall, results indicate that lacking managers *is* a barrier to institutions participating in sustainable ICT projects and the term lacking incorporates a variety of institutional issues, each a barrier in its own right. See Appendix XII.41 for a full analysis of the responses to this question.

5.21 Overall Analysis of Responses to Irish Survey.

Results indicate that barriers to participation in sustainable ICT projects exist in FHE institutions in the Republic of Ireland and that they exist for a number of reasons, namely, being under resourced for new technology, for support staff and for training an upskilling. Similar to the UK survey those barriers could be overcome or at least diminished through effective communication from senior management coupled with education on the institutional benefits of the use of more sustainable technology. However, the Irish survey was a little biased as no environmental/sustainability managers took park in the survey and 12% of respondents even indicated that their institution was not lacking in anyway.

For the purpose of achieving a greater understanding of each of the seven barriers at doctoral level, both the UK and Irish surveys required further, comparative analysis. In doing so, the researcher would establish if similarities or differences between the various categories of participants existed with regards to

5.22 Chapter 5 Part II: Cross-Comparison of UK and Irish Survey Results.

This part of Chapter 5 compares the results of the UK and Irish surveys from three different standpoints.

5.23 UK Versus Ireland.

Comparison of Job Titles between UK and Irish Respondents.

It was decided to compare the results of the UK and Irish surveys from three different aspects. Those aspects included a comparison of:

1. Responses from Irish managers versus UK managers, to establish any similarities and/or differences between the two datasets, thereby identifying any cultural divides or likenesses.
2. Responses from managers in London institutions versus those located in the rest of the UK. This was to establish any similarities and/or differences in responses from managers between the two UK locations. Another reason for this comparison was the fact that the majority of respondents in the UK survey were from London institutions and the researcher decided to make this the focus of an analysis.
3. Responses from ICT/IT managers versus Environmental/Sustainable managers versus Other managers. This was to also establish any similarities and/or differences between these three categories of job roles. These three job roles were chosen as they had the greatest number of respondents.

5.23.1 Ireland Versus the Rest of the UK Responses.

The first question was deemed incomparable as it asked a different question for the UK and Irish surveys. The UK survey questioned institutions' regional location across the UK, whereas the Irish survey simply asked respondents to name the organisation they worked for.

The second question was comparable as it compared job roles between the two countries. Respondents were asked which title in Table 5.11 best describes their current role at their institution and offered nine possible answer options. Respondents were only allowed to choose one answer option and a comparison of answer responses is summarised in Table 5.11 below.

Table 5.11 Comparison of Job Titles between UK and Irish Respondents

Job Role	Number of UK Respondents	Number of Irish Respondents
ICT/IT Manager	11 (18.34%)	10 (62.5%)
Environmental/Sustainable Manager	15 (25%)	0
Energy Manager	3 (5%)	0
Space Manager	0	0
Estates and Facilities Manager	2 (3.33%)	1 (6.25%)
Procurement/Finance Manager	2 (3.33%)	1(6.25%)
Carbon Manager	0	0
Utilities Manager	1 (1.67%)	0
Other	26 (43.33%)	4 (25%)
Total	**60**	**16**

5.23.2 UK versus Ireland Responses to Role at Institution.

As can be seen from Table 5.11, the category of ICT/IT managers in the Republic of Ireland had the greatest populace of survey respondents. For the UK survey it was Other managers. Estates and facilities managers and procurement/finance managers from both countries also responded but only at a minimal level. These results indicate either poor participation from certain categories of managers, particularly in the Republic of Ireland, or that certain institutions do not employ these types of managers. Instead those responsibilities are under the remit of other managers. For example, the energy manager in some institutions is also the carbon manager and carries out many of the environmental/sustainable tasks too. For a more detailed analysis of the responses to this question, see Appendix XII.42.

5.23.3 Comparison of Length of Time in Current Role.

A comparison of the six categories of number of years regarding length of time for which respondents from both countries had been in their current role, was carried out. This was done in order to establish which country had managers who had been

in their roles the longest and if it affected their responses to questions. The majority of UK FHE managers were in their roles five years or less, indicating a workforce with relatively few years of experience. The number of managers declined significantly (by approximately 50–75% with each decade) as the length of time in their roles increased. In contrast, the number of Irish managers remains the same as the length of time in their roles increased, but then declines to just 6.25% (one) for managers with sixteen to twenty-five years' experience and then to zero for managers with greater than twenty-one years' experience. This indicates that respondents to the Irish survey are from managers with twenty years' experience, or less, in their job role. See Appendix XII.43 for details.

5.23.4 Comparison of Length of Time in FHE Sector.

Respondents were asked the approximate number of years they had worked in the university and college sector and their responses indicated that the majority of UK FHE managers have been working in the sector for five years or less. As the numbers of years increase, the number of survey respondents decreases with the result that only four of the UK survey respondents are working in the FHE sector after twenty-six years. Similarly, in the Irish survey, the majority of respondents had been working in the sector for five years or less. As the number of years worked in the sector increases, the number of survey respondents decreases, with the result that only one Irish survey respondent worked in the FHE sector for twenty-five years. The data regarding patterns in number of years worked in the sector by both UK and Irish respondents indicates similar, if slightly erratic patterns, but is not unusual. See Appendix XII.44 for details.

5.24 Stakeholder Engagement.

The results are similar for surveys from both countries. Large percentages of responses indicating stakeholder engagement when implementing greener ICT initiatives were found, except in the UK survey where more than half (51.04%) of the survey respondents indicated that stakeholders were *Neither Engaged nor Disengaged*. In contrast, managers from Irish institutions answered that stakeholders were both *Engaged* and *Neither Engaged nor Disengaged* in equal amounts. Institutions from both countries indicated that they had tried to implement initiatives indicating an awareness of greener ICT and a willingness to reduce carbon

emissions and running costs. A table of comparison of results is summarised in Table 5.12 below.

Table 5.12 Comparison between UK and Irish Institutions on Stakeholder Engagement.

Stakeholder Engagement.	UK	Ireland
Yes.	18 (36.73%)	7 (43.75%)
No.	6 (12.24%)	2 (12.5%)
Neither Engaged nor Disengaged.	25 (51.04%)	7 (43.75%)
We have not tried to implement greener ICT in our institution.	0	0
Total	**49**	**16**

5.24.1 Comparison of Responses Stakeholder Engagement.

As before, survey respondents who answered *Yes* to Stakeholder Engagement were then asked to choose from four answer options as to why they chose that answer.

Those reasons were then compared against each other. Results from institutions in both countries were similar in that each of the *Yes* answer options resonated with respondents from both countries, albeit to varying degrees. Informing stakeholders of a transition to the use of greener technologies was key to engagement in both countries. However, stakeholders at UK institutions appeared to support any initiative that reduced energy bills and carbon emissions more than replacing older technologies that had started to slow down or fail. In Irish institutions, this proved to be less of a reason for engagement and it was more that stakeholders were informed of why a switch to greener technology was being made, as well as feeling included in the decision-making process. Stakeholders from both countries differed in their inability to engage with greener ICT, but they agreed that switching did not necessarily lead to a disruption of services.

However, they differed in that only the Irish institutions indicated that stakeholders did not like having to adjust to green ICT initiatives and only UK institutions indicated that switching to greener ICT required behavioural change or that stakeholders

expressed their lack of confidence in "green ICT" i.e. new technology not being very green. For those who answered *Neither Engaged nor Disengaged,* the majority of UK respondents, 58% (fourteen), stated that their stakeholders did not really have an opinion on the switch to greener technology, some protested, some were vocal supporters, most said nothing. However, stakeholders' ambivalence in Irish institutions was mainly due to *not* being informed of the changes to greener ICT; instead, changes happened gradually over the course of the year. Respondents in both the UK and Irish surveys also indicated that their stakeholders' ambivalence and disinterest in green ICT was due to them not really having an opinion on the switch to greener technology, with some protesting, some being vocal supporters, but most saying nothing. Overall, the results indicate both similarities and difference between the two countries when attempting to engage with stakeholders when implementing green ICT. For a more detailed analysis of the responses to this question see Appendix XII.45–XII.48

5.25 Culture of Green ICT

For institutions in both the UK and Ireland, participating in green ICT projects is typical of their culture as the majority of responses, 51% (twenty-one) and 43% (six) respectively, indicated this. However, respondents from both countries also indicated that participating in green ICT projects was *not* typical of their institutions' culture in similar amounts too, 27% and 21.4% respectively. Finally, just as many respondents indicated it was neither typical nor not typical of their institution to participate in a sustainable ICT project. The lack of extreme data, 10% or less or 90% or more, for any single response indicates that green ICT is part of FHE institutions' culture on both sides of the Irish Sea, albeit to a moderate extent. Those results are summarised in Table 5.13.

Table 5.13 Comparison of Responses to Culture of Green ICT in UK and Irish Institutions.

Green ICT projects typical of your institution's culture	UK	Ireland
Yes	21 (51%)	6 (43%)
No	11 (27%)	3 (21.4%)
Neither typical nor non-typical	9 (22%)	5 (35.7%)
Total	41	14

5.25.1 Comparison of Yes Responses to Culture of Green ICT.

Overall results were mixed, with more than 80% of respondents from both countries stating that having an innovative and proactive senior manager who encouraged participation in green ICT projects affected their institutions' culture towards utilising greener technologies. This was followed by fewer responses from institutions in both countries, whose managers indicated being sector leaders in ICT research with strong links to other research organisations, so participating in a green ICT project was in fact, the norm.

Respondents from both UK and Irish institutions also indicated that green ICT was *not* part of their institutions' culture, because of a lack of interest on the part of their managers in participating in sustainable projects, green ICT or otherwise. Responses from UK institutions also indicated that failure on their part to deviate from teaching traditions was partially responsible for their institutions' not engaging with sustainable ICT projects, albeit it at a lower rate. However, in Ireland this was proven not to be the case as none of the survey respondents chose this answer. This indicates that some Irish institutions have managers who are not interested in participating in sustainable ICT projects but are also not concerned about their institutions' traditional teaching culture and did not regard this as a barrier.

UK and Irish survey respondents were asked to leave a comment explaining why they answered '*Neither Typical' nor 'not Typical'* when asked about green ICT being part of their institutions' culture. Comments indicated a culture in both countries of disconnection, ambiguity and ambivalence to greener ICT. This is primarily due to poor leadership. Survey respondents from both countries indicated a degree of knowledge about the implementation of greener technologies and which

departments should take charge, but also recognised that it was the responsibility of senior managers and/or nominated staff members to ensure carbon emissions are reduced and projects are completed. Results clearly indicate that regardless of the nationality of an institution, a passionate and proactive member of staff, who campaigns for greater engagement in environmentally sustainable projects, can effect cultural change and ultimately the carbon footprint of an institution. For a more detailed analysis of the responses to this question see Appendix XII.49–XII.51.

5.26 Government Organisations as Drivers.

As both countries have different government organisations as drivers, it was not possible to make a like-for-like comparison of the two datasets so no comparison was made.

5.27 Comparison of Responses to Green Technology Delivering on Financial and Carbon Savings.

A comparison of UK and Irish responses to the question pertaining to green technology delivering on the financial and carbon savings promised by IT companies was made and is summarised in Table 5.14 below.

Table 5.14 Comparison of Responses to Green Technology Delivering on Financial and Carbon Savings.

Green ICT technology delivers on the financial and carbon savings promised by IT companies?	UK	Ireland
Yes	6 (16%)	2 (17%)
No	6 (16%)	3 (25%)
Somewhat	25 (68%)	7 (58%)
Total	37	12

5.27. Comparison of Responses to Green Technology Delivering on Financial and Carbon Savings.

There is a closeness in percentage of response rates from the UK and Irish institutions as regards believing that green technology delivers on the financial and carbon savings promised by IT companies, with 16% (six) of the UK and 17% (two) of the Irish survey respondents indicating this. Responses from both surveys also

showed that the same number, and more, of respondents did not feel that green technology delivered on the financial and carbon savings promised by IT companies. However, overwhelmingly both UK and Irish institutions indicated that green ICT technology only *somewhat* delivered on the financial and carbon savings promised by IT companies. Overall, the results indicated similarity between the two countries regarding the response rate of each answer option.

Where the UK is concerned switching to MFDs and printing and copying double-sided proved to be the most popular of the sustainable ICT initiatives. Virtualisation of servers and cloud computing also proved popular, as did automatic power-down, installing green data centres and using video conferencing. Results are similar to that of the Irish survey as these same technologies proved to be the most popular in Ireland too. This may be due to their having a less complicated installation process and that MFDs, printing and copying double-sided by default and video conferencing are readily available in both countries and are straightforward to install and use. Technologies that did not score as well in both countries include automatic switch-off at 5pm, use of shared services, switch to thin client technology use of greener networks and switches, BYOD and Hoteling and Hot-Desking. This is likely to be because they cause an interruption to services, undermine data security or are not a good fit for some institutions.

For both countries, the purchase costs far exceeding any savings made was the main reason respondents decided that green technology did *not* deliver on the financial and carbon savings promised by IT companies. For UK respondents it was also because they could not see a reduction in energy costs and that by the time return on investment (R.O.I) was realised, technology was out of date. None of the Irish institutions indicated that not being able to see a reduction in energy costs was why they responded *No,* whereas as two of the UK survey respondents indicated that this was the reason. For a more detailed analysis of the responses to this question see Appendix XII.52–XII.54

5.28 Cuts in Funding

A comparison was made of the responses to the question on cuts in funding to establish if UK institutions were affected in the same way as those in Ireland were. While the cuts were not made by the same governments, their effects are likely to have been the same i.e. job losses, reduction in number of projects funded or reduction in resources.

Table 5.15 Comparison of Effects of Cuts in Funding of UK and Irish Institutions to Participate in Sustainable ICT projects.

Response	UK	Ireland
Yes	10 (27%)	5 (45.5%)
No	17 (45%)	5 (45.5%)
Somewhat	10 (27%)	1 (9%)
Total	37	11

5.28.1 Comparison of Responses to Cuts in Funding.

Combined, these data indicated that cuts in funding affected institutions ability to participate in sustainable ICT projects, which is contrary to the results of a preliminary survey carried out two years prior (Hogan, 2012). In contrast, results of the Irish survey indicated that as many respondents had their ability to participate in sustainable ICT projects affected by cuts in funding as those that did not. Only one Irish respondent indicated being *Somewhat* affected. This indicates that overall cuts in funding affect institutions' ability to participate in sustainable ICT projects to varying degrees in each country and can therefore be considered a barrier. For a more detailed analysis of the responses to this question see Appendix XII.55.

5.29 Purchasing Frameworks.

A comparison of UK and Irish responses to the question pertaining to belonging to a purchasing framework was carried out to establish if any similarities or differences existed between the budget-holders and decision-makers in institutions from both countries.

Table 5.16 Comparison of Responses from UK and Irish Institutions on belonging to a Purchasing Framework.

Supported in choice to purchase sustainable technology.	**UK**	**Ireland**
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT.	15 (42%)	2 (18%)
Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT.	8 (22%)	1 (9%)
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT.	2 (8%)	2 (18%)
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT.	0	0
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	4 (11%)	1(9%)
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	6 (17%)	5 (45%)
Total.	**35**	**11**

5.29.1 Comparison of Responses on Belonging to a Purchasing Framework.

Overall, responses to this question indicated a mixture of the presence and absence of purchasing frameworks in both UK and Irish institutions and, within the absence or presence of a purchasing framework, feelings of both support and non-support from respondents existed. A more detailed analysis and evaluation of the comparison of responses to these questions is given in Appendix XII.56

5.30 Lacking Managers.

A comparison of UK and Irish responses pertaining to the question on lacking ICT managers was made. Respondents were offered a choice of answer options and were invited to choose more than one answer option. This comparison was made to establish if there were similarities or disparities in responses and a comparison of the responses to this question are summarised in Table 5.17.

Table 5.17 Comparison of UK and Irish Responses on Lacking ICT managers.

Lacking Managerial Characteristics	UK	Ireland
Poor knowledge of green ICT issues.	10 (12%)	0
Disinterest in green ICT issues.	12 (14.45%)	3 (12%)
Disinterest in "outside" green ICT projects (i.e participating not requested from senior management).	7 (8.4%)	2 (8%)
Is negatively influenced by institutional politics.	11 (13.25%)	3 (12%)
Is under-resourced in terms of funding for new technology.	10 (12%)	6 (24%)
Is under-resourced in terms of allocation of support staff.	11(13.25%)	4 (16%)
Is under-resourced in terms of allowances for staff training, upskilling, etc.	10 (12%)	4 (16%)
None of the above.	12 (14.45%)	3 (12%)
Total	**83**	**25**

5.30.1 Comparison of Responses to Lacking Managers.

Poor knowledge of and disinterest in green ICT issues, being negatively influenced by institutional politics, being under-resourced in terms of funding for new technology, for allocation of support staff, for allowances for staff training and upskilling, each scored approximately the same i.e. between 12% and 14.45% in the UK survey. Only having a disinterest in "outside" green ICT projects scored lower. Surprisingly, a greater number of managers, more than 14% (twelve) indicated their ICT managers exhibited none of the lacking characteristics. Results from the Irish survey differed, with none of the Irish survey respondents indicating that their ICT managers had a poor knowledge of green ICT issues. This is not surprising as the majority of respondents in the Irish survey were IT or ICT managers and they are not likely to admit being disinterested in ICT of any type. Results also showed that the remainder of the lacking characteristics were as commonplace as one another. Being under-resourced in terms of funding for new technology was the most common response to this question from Irish respondents and similarly to the UK survey, having a disinterest in "outside" green ICT projects was the least common

response. A more detailed analysis of the responses to this question is given in Appendix XII.57.

5.31 Overall Comparison of Responses between UK and Irish Surveys.

Overall results of the UK and Irish surveys indicated a mixture of both similar and differing results when examining barriers to participation in sustainable ICT projects. Some answers indicated a strong similarity between the two countries such as belonging to purchasing frameworks where none of the respondents in either survey stated not being part of a framework and not feeling supported in decisions to purchase green ICT. Yet in other instances, they had opposite views; for example, on whether a barrier existed or not and to what extent. However, it is worth noting that as the majority of respondents in the Irish survey were ICT or IT managers the results are likely to be biased towards demonstrating competency in the knowledge and use of sustainable technology. In conclusion, each of the barriers existed in both countries to some extent.

5.32 London Versus Rest of UK.

As more than half of the UK survey respondents were from universities in the London region, it was decided that a comparative analysis of responses from London institutions and those from across the rest of the UK should be carried out. This would establish if there were any similarities and/or disparities between both datasets. Responses from the Irish survey were not included in this analysis as they are not part of the UK. The first question that compared London and the Rest of the UK responses pertained to respondents' job roles. Both datasets of responses are compared and summarised in table 5.18.

Table 5.18 Comparison of London and Rest of UK Job Roles.

Job Role	London	Rest of the UK
ICT/IT Manager	2 (6.45%)	9 (31%)
Environmental/Sustainable Manager	8 (25%)	7 (24.13%)
Energy Manager	2 (6.45%)	1 (3.44%)
Space Manager	0	0

Job Role	London	Rest of the UK
Estates and Facilities Manager	1 (3.25%)	1 (3.44%)
Procurement/Finance Manager	2 (6.45%)	0
Carbon Manager	0	0
Utilities Manager	0	1(3.44%)
Other	16 (52%)	10 (34.5%)
Total	31	29

5.32.1 Comparison of Responses to Role at Institution.

Overall the category of Other managers made up the bulk of survey respondents from both regions in the UK followed by ICT/IT managers and environmental/sustainable managers. As Other managers consisted of a mixture of administrative staff, senior management, academic staff and students, it offered a balanced approach to the research. However, when comparing results, the largest difference between the London and Rest of the UK respondents was the percentage of ICT managers who responded to the survey. 31% (nine) of responses from institutions across the Rest of UK came from ICT/IT managers, in comparison to London respondents where ICT/IT managers made up less than 7% of total respondents (See Appendix XII.58).

5.33 Comparison of Length of Time in Current Role.

A comparison of the London and Rest of UK responses to the question pertaining to the length of time respondents were in their current job was made to establish any disparity or similarity between the two datasets.

5.33.1 Comparison of Responses to Length of Time in Job Roles.

Results are somewhat similar in that the majority of managers from both regions of the UK have been in their roles five years or less, with the number of survey respondents decreasing as the length of time in their roles increased. The only exception to this is a slight increase for respondents in London institutions who indicated being in their roles sixteen to twenty years, then none of them had worked

between twenty-one and twenty-five years and just 3.1% of respondents (one) indicated having worked twenty-six to thirty years.
A similar exception occurred with respondents in the Rest of the UK, who experienced a slight increase (or doubling) in the number of respondents who were in their roles between twenty-one and twenty-five years. Overall, results indicate an experienced workforce with the majority of respondents from both regions having up to fifteen years' experience in their roles. For a more detailed analysis of the responses to this question, see Appendix XII.59.

5.34 Overall Comparison of Responses to Length of Time working in the University and College sector.

Responses from London and the Rest of UK institutions did not follow a similar pattern as in the previous question. Instead both regions had a mixture of increases and decreases in the number of respondents as the number of years in the sector increased. On average however, the numbers of respondents decreased as the number of years worked in the sector increased, for institutions in both UK regions. This gave an overall uneven distribution of input from experienced sector staff to the research (See Appendix XII.60 for more details).

5.35 Stakeholder Engagement.

Responses from both datasets relating to the question on stakeholder engagement were compared to establish any disparity and/or similarity. Respondents were asked "when implementing 'greener ICT' in your institution, were stakeholders (staff and students, other organisations etc.) engaged i.e. willing to adjust to changes in job roles, train in the use of greener technologies?" A summary of the comparison of those results is included in Table 5.19 and a more detailed analysis of the responses to each of the questions is given in Appendix XII.61

Table 5.19 Comparison of Stakeholder Engagement in Green ICT Projects London and Rest of the UK Institutions.

Stakeholder Engagement.	London	Rest of the UK
Yes	7 (32%)	11 (41%)

No	5 (22.72%)	1 (3.7%)
Neither Engaged nor Disengaged	10 (45.45%)	15 (55.55%)
We have not tried to implement greener ICT in our institution.	0	0
Total	22	27

5.35.1 Comparison of Responses to Stakeholder Engagement.

Greater engagement in sustainable ICT projects was found in institutions outside of London, indicating perhaps a greater sense of community in regions outside of the capital. This might also be because institutions outside of London tend to be smaller in size and therefore more manageable. As with previous comparisons, respondents who answered *Yes* to stakeholder engagement were then asked to choose from four answer options indicating why they chose that answer option. The researcher then decided to compare the *Yes* responses from London and Rest of the UK Institutions. See Appendix XII.62 for more details.

Overall, responses indicated a balanced approach to stakeholder engagement in sustainable ICT projects, regardless of geographical location of institutions. Results also indicated the holistic and engaging mindset of stakeholders in institutions across the UK when being asked to engage with the use of more sustainable technologies in the workplace. *Neither Engaged nor Disengaged* responses to these answer options differed between the two regions, albeit on a minimal level. Respondents from Rest of the UK institutions indicated a more complacent approach to green ICT initiatives and that half of this complacency was as a result of not being informed of changes to greener ICT, instead allowing them to happen gradually over the course of the year(s). This appears to be the best technique when implementing greener ICT initiatives, regardless of institutions' geographical region in the UK. See Appendix XII.63 for more details.

The *No* responses to this question were similar in some respects and opposite in others. Respondents from London institutions and from institutions in the Rest of the UK did not think that switching to greener ICT resulted in disruptions to services or that stakeholders did not like having to adjust to green ICT initiatives as both answer options scored zero. Instead, respondents from London institutions indicated that lack of engagement of stakeholders was caused by the requirement of behavioural

change and that stakeholders were not confident in the savings offered by green ICT. Respondents from institutions in the Rest of the UK also indicated that a lack of confidence in "green ICT" was a barrier, but did not indicate that that behavioural change was also one. See Appendix XII.64 for more details.

5.36 Culture of Green ICT.

Respondents from both London institutions and institutions from the Rest of the UK answered *Yes*, *No* and *Neither typical or Non-typical* when asked about their institutions' culture in varying amounts. Overall, results indicated a mixture of responses regarding green ICT being part of institutions' culture in both regions. However, there is a slight lean towards it *being part* of the culture in both London and Rest of the UK institutions and a more detailed analysis of the responses to each of the questions is given in Appendix XII.65.

Table 5.20 Comparison of Responses to Question on Culture of Green ICT between London and Rest of the UK Institutions.

Green ICT projects typical of your institution's culture	London	Rest of the UK
Yes	9 (53%)	12 (50%)
No	3 (17.64%)	8 (33.33%)
Neither typical or non-typical	5 (29.41%)	4 (16.66%)
Total	17	24

5.36.1 Comparison of Responses to Culture of Green ICT.

Having a very innovative and proactive senior manager who encouraged participation in sustainable ICT projects was the most popular reason given for choosing *Yes* when asked about ICT culture in their institution, for both London and the Rest of the UK respondents. In fact, for London respondents, it was the only reason. London respondents did not consider their institutions to be leaders in ICT research with strong links to other research organisations, nor did approximately 77% of respondents from institutions across the Rest of the UK. (See Appendix XII.66)

However, when comparing the London and the Rest of the UK's *No* responses to stakeholder engagement, responses indicated that senior managers were not

interested in participating in sustainable ICT projects and that their institutions were traditional in the subjects they taught and rarely deviated from them. London respondents answered this question in even amounts but for institutions from the Rest of the UK, they were less even. For the majority of institutions in the Rest of the UK, a disinterest by senior managers in green ICT was the main reason for green ICT not being part of their institutions culture. This indicated that for institutions in both regions, but primarily for those in the Rest of the UK, having a passionate and forward-thinking manager is key to success and not having one can be considered a barrier (See Appendix XII.67).

London and Rest of UK survey respondents were asked to leave a comment explaining why they answered '*Neither Typical' nor 'Not Typical'* when asked about green ICT being part of their institutions' culture. Managers from both groups indicated that implementing sustainable ICT initiatives was ad hoc and sporadic within their institution, required the participation of various departments to effect change and often only occurred with the agreement of senior management in an effort to reduce running costs. Overall, green ICT being part of the culture of FHE institutions in both London and Rest of The UK was mixed. Respondents supported this mixture via comments left and there is evidence of institutional culture being a barrier (See Appendix XII.68)

5.37 Government Organisations as Drivers.

Respondents were asked to choose, from six possible answer choices, their opinion on UK government organisations as drivers for green ICT projects. This was to establish if respondents from London institutions had the same experience as those from institutions across the Rest of the UK. Answer options included Excellent to Very Poor Driver, and comparisons of responses are given for each of the organisations in Table 5.21.

Table 5.21 Comparison of Responses from London and Rest of UK Institutions regarding Government Organisations as Drivers.

HEFCE	Excellent Driver	Very Good Driver	Good Driver	Neither Good Nor Bad Driver	Poor Driver	Very Poor Driver
London	1	0	5	5	1	0

Rest of the UK	5	0	8	6	2	0
DEFRA	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	0	0	2	8	3	0
Rest of the UK	1	0	4	13	2	1
DECC	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	1	0	3	8	2	0
Rest of the UK	2	0	3	12	3	1
Salix	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	0	0	5	7	1	0
Rest of the UK	5	0	4	8	4	0
Local Authority	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	0	0	1	7	3	1
Rest of the UK	1	0	2	11	4	1
Other	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	0	0	1	8	3	0

Rest of the UK	1	0	2	14	1	0

5.37.1 Comparison of Responses to Government Organisations as Drivers.

Responses from managers in both London and rest of the UK institutions indicated a mixture of results when examining UK government organisations that support FHE institutions, as drivers for participating in green ICT projects. The majority of organisations only scored “in the middle” when being considered as a driver for green ICT. Only HEFCE and the DECC were considered to be excellent drivers by respondents from London institutions, whereas each of the organisations listed were considered to be excellent drivers by at least one respondent from at least one institution in the Rest of the UK.

Supporting this positive feedback, most of the government organisations were not considered to be very poor drivers by any of the respondents from either London or the Rest of the UK institutions, except for one respondent who indicated that local authorities were. Surprisingly, none of the government organisations were considered to be very good drivers by respondents in either London or the Rest of UK institutions either. The category of *Neither Good nor Bad Drivers* scored the highest results from respondents in both London and the Rest of the UK institutions, indicating a weakness in government organisations to act as drivers to affect participation in green ICT projects and thereby reduce carbon emissions. Each of the organisations listed were considered to be poor drivers by both London and Rest of the UK institutions. Only Local Authorities, DEFRA and the DECC were considered to be very poor drivers (See Appendix XII.69).

5.38 Performance of Green ICT.

A comparison between the responses from the London and Rest of UK institutions was made in relation to the performance of green technology in delivering on the financial and carbon savings promised by IT companies. This comparison would establish any similarities or differences in opinions between respondents from both regions and is summarised in Table 5.22. For a more detailed analysis of the responses to each of the questions is given is Appendix XII.70.

Table 5.22 Comparison of Responses from London and Rest of UK Institutions pertaining to Performance of Green ICT.

Green technology delivering on the financial and carbon savings promised by IT companies?	London	Rest of the UK
Yes	1 (6.66%)	5 (22.7%)
No	2 (13.33%)	4 (18.18%)
Somewhat	12 (80%)	13 (59.09%)
Total	15	22

5.38.1 Comparison of Responses Performance of Green ICT as a Cost and Carbon Saver.

Results indicated that green ICT's reputation as a cost and carbon saver amongst London institutions was very low. Similarly, a very low percentage of the Rest of the UK indicated that green ICT delivered on cost and carbon savings too, with the majority stating that it only *somewhat* did. Less than 20% of respondents from institutions from both regions stated they did *not* believe in the savings offered. Managers from both London and Rest of the UK institutions implemented each of the technologies listed, with the exception of London institutions, who indicated *not* inviting students to bring their own devices. Overall a range of sustainable ICT initiatives were implemented in institutions across the UK. This represented the holistic approach recommended by the JISC Greening of ICT Programme manager and the SUSTE-TECH project manager when attempting to reduce ICT running costs and carbon emissions (See Appendix XII.71).

However, the *No* responses from managers in London and the Rest of UK institutions varied. None of the London managers indicated that they could not see a reduction in energy costs or that by the time R.O.I was realised, technology was out of date. Only one manager indicated that costs far exceeded any savings made. These results indicated sector confidence in the ability of greener technologies to create cost and carbon savings. However, managers in institutions in the rest of the UK indicated otherwise. They could not see a reduction in energy costs and thought that purchase costs far exceeded any savings made and that by the time R.O.I was realised, technology was out of date. Overall, only ten managers out of sixty

indicated not believing that green ICT delivered in cost and carbon savings, demonstrating support from the sector in the cost and carbon savings afforded through the use of more sustainable technology (See Appendix XII.71).

5.39 Comparison of Responses to Cuts in Funding.

This comparison was made to establish any similarities or disparities between responses from London institutions and those in the Rest of the UK regarding effects of cuts in funding to their institution. Respondents were asked to choose between answer option *Yes, No or Somewhat* and a comparison of those results is summarised in Table 5.23 below.

Table 5.23 Comparison of Responses from London and Rest of UK Institutions to question pertaining to Cuts in Funding.

Affected by Cuts in Funding.	London	Rest of the UK
Yes	3 (21.42%)	7 (30.43%)
No	7 (50%)	10 (43.47%)
Somewhat	4 (28.57%)	6 (26%)
Total	14	23

5.39.1 Comparison of Responses to Cuts in Funding.

Responses indicated a similarity in results from both London and Rest of the UK institutions. Respondents from both datasets answered *Yes*, *No* and *Somewhat* in similar amounts with no significant disparity in responses (See Appendix XII.73). The majority of respondents from both geographical regions indicated their institutions were not affected by cuts in funding. This indicated that cuts in funding were a barrier to institutions regardless of geographical location. However, overall results also indicated that cuts in funding did not adversely affect other institutions and these results mirror the results of a preliminary survey carried out in 2012 (Hogan, 2012). That survey concluded that cuts in funding inhibited sustainable projects from progressing in some institutions, whereas other institutions saw it as an opportunity to operate even more sustainably. A more detailed analysis of the responses to each of the questions is given in Appendix XII.73.

5.40 Comparison of Responses to Purchasing Frameworks.

A comparison of responses to the question pertaining to membership of a purchasing framework between London and Rest of UK institutions was carried out to establish if survey respondents from both geographical regions of the UK had the same experiences.
Each of the five possible answer options from both datasets were compared and summarised in Table 5.24 below.

Table 5.24 Comparison of Responses pertaining to Membership of a Purchasing Framework between London and Rest of the UK Institution.

Part of a Purchasing Framework	London	Rest of the UK
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT.	4 (30.76%)	11 (50%)
Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT.	4 (30.76%)	4 (18.18%)
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT.	1 (7.69%)	1 (4.54%)
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT.	0	0
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	1(7.69%)	3 (13.63%)
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	3 (23.07%)	3 (13.63%)
Total	13	22

5.40.1 Comparison of Responses to Membership of a Purchasing Framework.

Results showed that most institutions belonged to a purchasing framework of sorts, as only two survey respondents, one from a London institution, the other from an institution outside of London, stated they were *not* part of a framework. However, they both indicated feeling supported in their decisions to purchase green ICT. Overall, results indicated a mixture of both knowledge and lack of knowledge

regarding their institutions' membership of purchasing frameworks, resulting in mixed feelings of support decisions to purchase greener technologies. This is a barrier for those wanting to purchase greener technologies but feeling unsupported in doing so. A more detailed analysis of the responses to each of the questions is given in Appendix XII.74

5.41 Lacking Managers

A comparison between the responses from London and the Rest of the UK institutions regarding lacking ICT managers was made to establish whether there were any similarities between responses from institutions in London and those in the rest of the UK. The researcher decided to investigate various aspects of a manager's role to establish possible reasons why they appeared to be lacking. Survey respondents were asked to choose from eight answer options, to describe lacking characteristics of their institution's ICT managers, and as previously, were invited to choose more than one answer option where applicable. Responses were compared and are summarised in Table 5.25 and a more detailed analysis of responses to this question is given in Appendix XII.75.

Table 5.25 Comparison of Responses Pertaining to Lacking Managers in London and Rest of UK Institutions.

Characteristics of Lacking Managers.	London	Rest of the UK
Poor knowledge of green ICT issues.	3 (13.63%)	7 (14.28%)
Disinterest in green ICT initiatives.	3(13.63%)	9 (18.36%)
Disinterest in "outside" green ICT projects (i.e. participating not requested from senior management).	2 (9%)	5 (10.20%)
Is negatively influenced by institutional politics.	4 (18.18%)	7 (14.28%)
Is under-resourced in terms of funding for new technology.	3(13.63%)	7 (14.28%)
Is under-resourced in terms of allocation of support staff.	4(18.18%)	7 (14.28%)
Is under-resourced in terms of allowances for staff training, upskilling, etc.	3(13.63%)	7 (14.28%)

Characteristics of Lacking Managers.	London	Rest of the UK
None of the above.	5 (22.72%)	7 (14.28%)
Total Number of Lacking Characteristics.	22	49

5.41.1 Comparison of Responses to Lacking Managers.

Results were mixed, with twenty-two London respondents and forty-nine 'Rest of the UK' respondents indicating that ICT managers at their institutions exhibited each of the lacking characteristics. The most prevalent lacking characteristic from respondents from institutions in the Rest of the UK was disinterest in green ICT initiatives with 18.36% (nine) respondents choosing this answer option. Overall ICT managers in institutions across the UK are lacking and this appears to be a barrier. However, responses also indicated that much of the barriers appear to be outside of their control, as being negatively influenced by institutional politics, being under-resourced in terms of funding for new technology, allocation of support staff, and allowances for staff training and upskilling, is primarily due to institutional funding and how it is allocated by senior management. Three of the answer options: poor knowledge of green ICT issues, disinterest in green ICT initiatives, "outside" (or even as an in-house) cost- and carbon-reducing initiative, have also proven to be barriers. However, these can be controlled and improved through the input of more enthusiastic, passionate and innovative ICT/IT managers (See Appendix XII.75).

5.42 Overall Comparison of Responses from London and Rest of the UK Institutions.

Overall the survey has evidenced how London institutions appear to be more sustainably minded and appear to take action where practicable. This may be due to the researcher being part of the London Universities Environmental Group (LUEG) and as such the level of support appears to have loaned itself to a greater number of survey participants and/or facilitated managers in their ability to do their job. This is evidenced in the disparity in replies from respondents in London institutions and their cohorts in institutions across the UK. Similarly, many of the barriers are experienced to the same extent, regardless of regional location. There

appears to be a strong sense of community within the London universities and this was evidenced in the number of responses to the survey.

5.43 Influence of Job Roles on Responses

This section of the chapter examines and compares the response from ICT/IT managers, Environmental/Sustainability managers and respondents who categorised their job roles in the category of 'Other Manager'. In order to get a better idea of the mind-set of these groups of FHE managers, the results of both the UK and the Irish Survey were combined. This allowed the researcher to examine and compare the responses of a total of twenty-one ICT or IT managers, fifteen Environmental or Sustainability managers and thirty Other managers. The researcher decided to omit Energy Managers, Space Managers, Estates and Facilities Managers, Procurement or Finance Managers, Carbon Managers and Utilities Managers from this analysis as their numbers were too low to be included in the comparison. Their input is, however, summarised at the end of this chapter. Finally, the researcher chose the responses of only a selection of questions from both surveys, as it was decided that only these questions were relevant to establishing if the barriers existed or not and to what extent (See Appendix XII.76).

5.44 Stakeholder Engagement.

A comparison of responses from each of the three types of managers was made regarding stakeholder engagement at their respective institutions. Each survey respondent was asked "When implementing 'greener ICT' in your institution, were stakeholders (staff and students, other organisations etc.) engaged i.e. were they willing to adjust to changes in job roles, train in the use of greener technologies etc.?" Their responses are summarised in Table 5.26.

Table 5.26 Comparison of Responses from ICT/IT, Environmental/Sustainability Manager and Other Managers regarding Stakeholder Engagement in ICT projects.

Job Role	Yes	No	Neither Engaged nor Disengaged
ICT/IT Manager (21)	43% (9)	10 % (2)	48% (10)

Environmental/ Sustainability Manager (15)	40%(6) *	13.33% (2)	26% (4)
Other (30)	27 % (8)	10% (3)	43% (13)

Env/Sust. managers did not participate in the Irish survey

5.44.1 Comparison of Responses to Stakeholder Engagement.

Less than 80% of environmental/sustainability respondents and only 80% of Other respondents answered the questions relating to stakeholder engagement, whereas 100% of ICT/IT respondents answered this question. However, the disparity in the percentage response rate to the *Neither Engaged nor Disengaged* answer was significant. Only 26% (four) of environmental/sustainability managers indicated that stakeholders were *Neither Engaged nor Disengaged* in comparison to 48% (ten) and 43% (thirteen) of ICT/IT and Other managers respectively. The similarity in percentages of *Yes* and *No* answers to engagement may be due to ICT/IT and environmental/sustainability Managers being closer to stakeholders and are more likely to be monitoring engagement as it is they who typically run green ICT projects and would have a clearer idea of whether stakeholders were engaged or disengaged. However, the disparity in percentage responses of stakeholders being *Neither Engaged nor Disengaged*, with ICT managers responding at a 48% rate and Environmental or Sustainability managers responding at just a 26% rate, may be due to the fact that ICT/IT managers are only contacted by stakeholders when there is an issue with technology. So long as ICT systems are in working order ICT/IT managers are not likely to be contacted regarding ICT problems so may be perceived as being engaged. This is also likely to be why Other managers answered at a similar response rate. As implementing and participating in green ICT projects rarely falls under the remit of Other managers, they are not as close to stakeholders as environmental/sustainable managers might be, and so are likelier to be less informed of the level of engagement or disengagement. This answer option proved too vague for environmental/sustainable managers whose response rates to answer options *Yes* and *No* were higher. A more detailed analysis of the responses to this question is given in Appendix XII.77.

5.45 Culture of Green ICT.

A comparison of responses from each of the three types of managers was made regarding a culture of Green ICT at their respective institutions. Each survey respondent was asked to choose from three possible answers, *Yes*, *No* and *Somewhat*, regarding a possible culture of participating in green ICT projects at their respective institutions and their responses are summarised in Table 5.27.

Table 5.27 Comparison of Job Role Responses Regarding Culture of Green ICT.

Job Role	Yes	No	Neither Typical nor or Non-Typical
ICT/IT Manager	48% (10)	19% (4)	19% (4)
Environmental/ Sustainability Manager	33% (5)	20% (3)	20%(3)
Other	27% (8)	20% (6)	20% (6)

5.45.1 Comparison of Responses on Culture of Green ICT.

The percentage level of responses to the Yes answer from ICT or IT, Environmental or Sustainability and Other managers varied. However, percentage levels of '*No'* and '*Neither Typical' nor 'Non-Typical'* responses for all three categories of managers were very close, reaching between 19% and 20%. Overall, this table of results indicated little or no difference between the '*No'* and '*Neither Typical' nor 'Non-Typical'* responses from each of the three categories of managers. The only disparity in results is from managers who answered '*Yes'* to green ICT being part of their institutions' culture. This indicates that a culture or lack thereof of the use of greener technologies is regarded as a barrier more than it is not by a variety of FHE managers (See Appendix XII.78).

5.46 Government Organisations as Drivers.

ICT/IT, environmental/sustainability and other managers each responded to the question regarding the six UK government organisations that were identified as possible drivers. Their responses for each organisation as a driver, were compared and a summary of their responses is included in Table 5.28 and in Appendix XII.79.

Table 5.28 Comparison of Job Role responses regarding Government organisations as Drivers.

HEFCE.	Excellent Driver	Very Good Driver	Good Driver	Neither Good Nor Bad Driver	Poor Driver	Very Poor Driver
ICT/IT Manager	1	0	3	4	1	0
Environmental/ Sustainability Manager	4	0	3	1	1	0
Other	0	0	6	5	1	0
DEFRA.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	1	5	0	1
Environmental/ Sustainability Manager	0	0	2	7	1	0
Other	0	0	2	7	3	0
DECC.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	1	4	1	1
Environmental/ Sustainability Manager	0	0	3	6	1	0
Other	1	0	2	6	3	0
Salix.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	2	0	1	4	0	0
Environmental/	2	0	4	3	1	0

Sustainability Manager						
Other	0	0	3	6	3	0
Local Authority.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	0	5	1	1
Environmental/ Sustainability Manager	0	0	1	5	3	0
Other	0	0	2	5	3	1
Other Organisations.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	2	6	0	0
Environmental/ Sustainability Manager	1	0	0	7	1	0
Other	0	0	0	7	3	0

5.46.1 Comparison Responses to Government Organisations as Drivers.

Overall there was a mixture of results indicating that HEFCE was considered a Good Driver, Neither a 'Good' Nor 'Bad Driver' and a 'Poor Driver' by all three categories of managers. None of the managers in all three categories of job roles indicated that DEFRA was either an Excellent Driver or a Very Good Driver. With the exception of one ICT/IT manager, they each also indicated that DEFRA was a very poor driver. This proves that certain government organisations are considered barriers to implementing green ICT initiatives by certain categories of managers.

5.47 Performance of Green Technology

A comparison of the responses from ICT or IT, Environmental/Sustainability and Other category of manager relating to green ICT delivering on the financial and

carbon savings promised by IT companies was made and a summary of those comparisons is included in Table 5.29 and Appendix XII.80.

Table 5.29 Comparison of Responses from Various Job Roles regarding Performance of Green Technology.

Job Role	Yes	No	Somewhat
ICT/IT Manager	10% (2)	24% (5)	38% (8)
Environmental/ Sustainability Manager	0%	7% (1)	60% (9)
Other	10% (3)	10% (3)	40% (12)

5.47.1 Comparison of Responses to Financial and Carbon Savings.

Just 10% (two) of ICT/IT managers and 10% (three) of Other managers agreed that green technology delivers on the financial and carbon savings promised by IT companies. Surprisingly none of the environmental/sustainability managers indicated the same. Overall the mixture of results (with one exception) indicated that green ICT's ability to deliver on promised savings is sometimes considered a barrier. A more detailed analysis of the response to this questions is given is Appendix XII.80.

5.48 Cuts in Funding.

Cuts in funding were likely to have affected different job roles in different ways. A comparison of effects of cuts in funding between each the three job roles is summarised in Table 5.30.

Table 5.30 Comparison of Responses from Various Job Roles regarding Effects of Cut in Funding.

Job Role	Yes	No	Somewhat
ICT/IT Manager	43% (9)	33% (7)	0%
Environmental/Sustainability Manager	0%	33% (5)	33% (5)

Other	17% (5)	23% (7)	20% (6)

5.48.1 Comparison of Responses to Cuts in Funding.

43% (nine) of ICT/IT managers and 17% (five) of Other managers indicated that their institution had been affected by cuts in funding to the sector. Surprisingly, none of the environmental or sustainability managers stated that they had been affected. The zero percentage response rate from Environmental or Sustainable managers, on questions relating to cuts in funding and green technology delivering on cost and carbon savings, indicated that examining the financial aspects of environmental projects, may not always fall under the remit of many environmental/ sustainable or ICT/IT managers but instead is managed by procurement and finance managers and those working in administration. Therefore environmental/sustainable managers do not always "see" the savings made or effects of cuts in funding. A more detailed analysis of the responses to this questions is given in Appendix XII.81.

5.49 Comparison of Responses from ICT or IT, Environmental or Sustainability Managers and Other Managers to Membership of Purchasing Frameworks.

To establish any disparity in responses from managers regarding how budget-holders and decision-makers and/or membership of a purchasing framework might affect their institutions' ability to implement greener ICT initiatives, responses from each of the three job roles were compared. Survey respondents were invited to choose more than one answer option and results are summarised in Table 5.31.

Table 5.31 Comparison of Responses from ICT/IT, Environmental or Sustainability Managers and Other Managers regarding Purchasing Frameworks.

Responses	ICT/IT Manager	Environmental/ Sustainable Manager	Other
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT.	3 (33%)	5 (55.55%)	5 (35.71%)

Responses	ICT/IT Manager	Environmental/ Sustainable Manager	Other
Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT.	1 (11%)	3(33%)	4 (28.57%)
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT.	1 (11%)	0	1 (7.14%)
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT.	0	0	0
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	3 (33%)	0	1(7.14%)
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	1 (11%)	1 (11%)	3(21.42%)
Total Number of ICT/ IT Managers who replied.	9 (100%)	9 (100%)	14 (100%)

5.49.1 Comparison of Responses to Membership of Purchasing Frameworks.

Results are mixed with 33% (three) of ICT/IT managers, 55% (five) of environmental/sustainable managers and 35.71% (five) of Other managers indicating their institutions *were* part of a framework and they felt supported in their decisions to purchase green ICT. Results indicated a general mix of responses from each of the categories of managers with the majority of managers from all three categories of roles being aware of their institution belonging to a framework of sorts, but not necessarily feeling supported by the budget-holders and decision-makers in their decision to purchase greener ICT. Similarly to the outcomes of previous comparisons, results indicate a mixture of responses indicating both the presence

and absence of frameworks being a barrier. A more detailed analysis of the responses to this questions is given in Appendix XII.82.

5.50 Lacking Managers.

Survey respondents were asked if their institutions' ICT/IT manager(s) were "lacking" by exhibiting any of the characteristics below and their responses are summarised in Table 5.32. The aim of this comparison was to see if each category of manager experienced the same lacking characteristic.

Table 5.32 Lacking characteristics exhibited by ICT manager(s).

Lacking Characteristics	ICT/IT manager.	Environmental /Sustainable Manager.	Other.	Total Number of Respondents for each Lacking Characteristic
Poor knowledge of green ICT issues.	3 (37.5%)	2 (25%)	3 (37.55%)	8
Disinterest in green ICT initiatives.	2 (14.28%)	3 (21.42%)	9 (64.28%)	14
Disinterest in "outside" green ICT initiatives.	2 (25%)	2 (25%)	4 (50%)	8
Is negatively influenced by institutional politics.	1 (7.69%)	3 (23.07%)	9 (69.21%)	13
Is under-resourced in terms of funding for new technology.	4 (25%)	5 (31.25%)	7(43.75%)	16

Lacking Characteristics	ICT/IT manager.	Environmental /Sustainable Manager.	Other.	Total Number of Respondents for each Lacking Characteristic
Is under-resourced in terms of allocation of support staff.	5 (33.33%)	6 (40%)	4(26.66%)	15
Is under-resourced in terms of allowances for staff training, upskilling, etc.	4 (28.57%)	4 (28.57%)	6 (42.85%)	14
None of the above.	7 (50%)	2 (14.28%)	5 (35.71%)	14

5.50.1 Comparison of Responses on Lacking characteristics of ICT managers.

Overall the results are quite similar, with each of the categories of managers identifying with each of the lacking characteristics of their institution's ICT managers. The largest lacking characteristic recognised was being negatively influenced by institutional politics, with the majority of other managers indicating this as a barrier also. In contrast, this was also the least commonly occurring lacking characteristic where ICT/IT managers were concerned. Other managers indicated that their institutions' ICT managers were negatively influenced by institutional politics, yet only one ICT/IT manager indicated this characteristic. However, when each of the lacking characteristics are totalled, being under-resourced in terms of funding for new technology is the most common barrier to participation in sustainable ICT projects, resonating with a total of sixteen managers. Other commonly-found barriers include being under-resourced in terms of allocation of support staff, allowances for staff training and having a disinterest in outside green ICT, amongst others. In contrast, fourteen respondents indicated that their ICT managers were not lacking in any of the characteristics mentioned. Overall, responses from each

category of job role indicate that each of the barriers exists to varying degrees according to all three categories of managers. Results were mixed, but similar, with no overwhelmingly strong indication of a significant difference in responses to any of the questions asked. A more detailed analysis of the response to this questions is given in Appendix XII.83.

5.51 Semi Structured Interviews.

To ensure a robust and reliable dataset that demonstrated triangulation with previous datasets, a series of follow-up semi structured interviews was conducted to validate the larger dataset. In total, fifteen people were interviewed as a follow up to the responses of the larger UK and Irish survey. These semi structured interviews were designed with reiteration and validation of responses to the larger survey in mind. They were also conducted to contribute to answering the research's sub-question; what are the key implications of those barriers? Participants were reminded of their responses to their original survey and asked if they would still give the same responses. The same ethical principles of confidentiality and not coercing responses from participants, covered in Chapter 3, applied.

The fifteen interviewees included seven ICT/IT managers and eight environmental/sustainability managers and their responses. The 15 interviewees consisted of seven respondents from the main survey and eight new participants who had previously not taken part in the main survey. This allowed for further data triangulation and also added a dynamic of input from a fresher perspective. Seven main themes based on each of the barriers emerged from the interviews.

Table 5.33 Categorisation of role of participants in semi-structured interviews.

Type of FHE Manager.	Previously Interviewed.	New Participants.
ICT Manager	4	4
Environmental /Sustainability.	3	4
Total.	7	8

Stakeholder Engagement.

Responses to the UK and Irish main survey indicating that stakeholders were neither engaged nor disengaged was unchanged, with just four respondents stating that engagement had improved slightly. The consensus was that participating in a sustainable project of some sort (Green Impact, EcoCampus, SUSTE-TECH) helped engage stakeholders with their ICT-related energy use as it made monitoring of energy use easy and progression of efforts measurable. Engagement seemed to improve when savings were then communicated to staff and students across campus as this seemed to encourage behavioural change further.

"When implementing greener ICT initiatives a small number bought into it, the rest were neither engaged nor disengaged. However, engagement has grown since savings from ICT were measured and these savings have been communicated". (ICT/IT manager)

"I've noticed a bit more engagement at the moment, but not specifically for green ICT, only because we have just now started Green Impact. However there is a bit of green ICT in Green Impact with notices to switch everything off." (Environmental/ Sustainability Manager)

"Since completing the survey in 2015 I have noticed a difference in the benefits of being more sustainable. For e.g. participating in EcoCampus. In the last month, clients (Irish universities and colleges) have contacted HEAnet asking for help with ideas for energy savings. This engagement and interest in energy saving techniques increased when the Sustainable Energy Association of Ireland (SEAI) started a new programme to tackle energy use and reduce CO_2 emissions as they are the main driver for change in the Rep of Ireland."(Irish ICT/IT Manager)

"At one point, we had no metering of data centres but now we do. ICT managers especially were surprised at the amount of energy data centres use and since seeing it, are more careful of energy use." (ICT/IT Manager)

Respondents added how energy agencies were being contacted for advice and stakeholders seemed enthused with information available regarding energy use of electrical devices where before they had not been to the same extent.

"At the time we regularly used the American Energy Star rating website to rate the energy use of our kit. We noticed a big change in staff engagement due to

energy star, it made monitoring easier and when staff could see how much energy they were using, they became more aware and conscientious." (ICT/IT manager)

However, other survey respondents were less enthusiastic about any improvements to stakeholder engagement where greener ICT was concerned. They stated that their institutions had done nothing to improve implementation of greener technologies and that any efforts to be greener were still being done on an ad-hoc basis.

"*There is no systematic implementation of green ICT, only traditional ICT in the institution that I work at. Green practices are done on an ad-hoc basis." (ICT/IT manager)*

The separation of energy bills from the departments was cited as being an underlying factor for disinterest in reducing energy use as well as a disbelief that green ICT can in fact significantly reduce energy use.

"Nothing has changed for us, stakeholder engagement is the same as before. ICT managers running ICT projects within the ICT department are not always aware of their associated energy usage. This is because they are not aware of what's involved. The problem is further compounded by the way the university manages its electricity bill. At our institution the bills per department/building are not separate, it is all added together so there is no distinction of who made the best savings, therefore there is no incentive to make any effort to reduce energy use. There is also no accountability for wasters of energy either." (ICT/IT manager)

Respondents added that overall, interest in sustainable issues had declined from both staff and students. This was mainly due to either course workloads or where staff are concerned not having permission to spend time on initiatives that were not considered "core business".

"Staff and students were not engaged and did not appear to care about their environmental impact or that of the institution's. Only students that were "into sustainability anyway" cared. In my institution the number of Green Impact teams is decreasing and this is due to students and staff caring less about the environment, and having too much personal work to do. Also there has

been no real directorate from directors of departments of estates to tackle carbon emissions." (Environmental/ Sustainability Manager)

"Junior staff in the IT department were interested but only if they had permission from line managers. They need permission to devote a certain amount of their working day to it." (Environmental/ Sustainability Manager)

Institutional Culture.

When asked about their institutions' culture, respondents stated that there was no marked improvement as regards green ICT playing a more central role in their culture since participating in the main survey. While some respondents indicated an improvement, this only came from one ICT/IT manager.

"They are quite engaged at the moment so green ICT is becoming part of a changing culture in institutions in Ireland." (Environmental/ Sustainability Manager)

Even then, any changes to culture were underpinned by being able to demonstrate savings.

"At our institution, the culture is very corporate, so we didn't have to implement a culture of green ICT. So long as you made the business case for savings and could then demonstrate those savings, then you would get funding." (ICT/IT manager)

One respondent (an IT/ICT manager) answered that as "core university business" that included the student experience had now become their culture, making money (via fees and funding) is essentially the main concern. Sustainability, while still present, was no longer considered core business.

"*There is a good green culture on campus. However, as regards green ICT, we are aware of being green but still we run a 24/7 service so 'servicing clients' is our priority. Some good ideas have worked in the past and if it is 'new and shiny' then SMT are on board, especially if the students have requested it. Failing that it, it is not a huge push to do green ICT." (ICT/IT manager)*

Being more sustainable where green ICT is concerned is still restricted by senior management's decision and any funding that might be available. Some respondents mentioned making efforts to procure for greener technologies a few

years prior to taking part in the survey, but added that it still had not happened. Any power a manager might have to effect culture change, is limited.

> *"There is no shift in culture, it is still the same as regards where we are applying the ICT kit. There are however elements of bring their own devices (BYOD) but we are limited as regards licencing." (ICT/IT manager)*

> *"Overall there is no culture of green ICT. However, the head of IT operations is a very committed and environmentally aware person but he is restricted by senior management's decision. We tried to procure for greener technologies a few years ago but it still has not happened, his power to effect change is limited. ICT managers are often restricted and asked to demonstrate performance and justify their spend but energy consumption does not come into it." (ICT/IT manager)*

> *"This is still the case, sustainability occurs in patches, it very much depends on the manager of the project itself, if he/she is enthusiastic, then the project will be successful." (ICT/IT manager)*

Government organisations as drivers.

The respondents stated that their responses to this question for the most part remained the same, with the notable exception of their downgrading of HEFCE. Since the remit of HEFCE had changed since 2012, FHE institutions no longer saw HEFCE as a main driver for ensuring carbon emissions are reduced. An Irish respondent named one particular Irish agency as still being an excellent driver.

> *"SEAI are now an excellent driver as it is they who issued the mandate in 2009 to examine and reduce energy use. Their target of a reduction of 20% of the historic average energy use during the period 2000–2005 has gotten everyone engaged and active. Building Management Systems (BMS) and sustainable construction have become very important as it is a clever and efficient way of reducing energy waste too." (ICT/IT manager)*

However, another UK respondent added that the government had done nothing significant to drive carbon reduction via implementing greener ICT. They added that, in fact, the UK government had almost reneged on any promise to support sustainability.

"There is more of a move towards greener technologies and the current government stated it was going to be the greenest government ever. What it has done in fact is made it more difficult to be greener." (Environmental/ Sustainability Manager)

"The biggest driver used to be the Salix fund but the performance factors were short-lived and replacement periods are too low. HEFCE are no longer issuing funding since their remit changed." (Environmental/ Sustainability Manager)

"*No change in my original survey response. External requirement from funding bodies are critical when trying to prove the sustainability of a project. There is very little chance of getting funding from your head of department, especially in ICT departments." (Environmental/ Sustainability Manager)*

Green technology delivering on the financial and carbon savings promised by IT companies?

The majority of the respondents reiterated how some of the technologies delivered on the financial and carbon savings promised and others did not. They did however agree that technologies became greener by default as their refresh date coincided with the release of smaller, faster, more energy-efficient kit. In that respect they were being greener but it proved to be more of a coincidence as opposed to a calculated choice based on carbon reduction targets.

"Yes and No. It happens by default, new kit is bought because the refresh date has been reached. The new kit is more energy-efficient anyway but really it's only a happy coincidence." (ICT/IT manager)

However, most managers interviewed agreed that they had witnessed a good deal of 'green-washing' within the sector as product marketing emphasised potential energy savings. On closer examination these savings are either extrapolated data or based on certain one-off trials or created in unrealistic environments.

"Some are good, some are not as good, and there is a lot of 'green-washing' going on. However, green ICT is simpler and it saves on electricity so you should be able to see the costs clearly. If there are no savings, it is likely to be because no-one is really looking at their energy bill or examining where and how they are wasting energy." (ICT/IT manager)

"There are incidents of over-claims and ICT managers are often mis-sold technologies, so lots of green-washing going on." (ICT/IT manager)

Respondents also mentioned that as energy reduction in FHEs is often the responsibility of "no one manager" then it makes the task of accurately measuring any improvements in ICT energy use almost impossible to determine.

"It is a bit better at the moment, but as before if technology is 'too new' managers will not go near it. Management want to see demonstrated saving from elsewhere first, only then will they consider it. They've looked at greener processing chips in PCs and carried out a comparison of cost and energy use. This was done in order to establish 'proven technology'. At the time they didn't look for greener credentials, they just looked at criteria of ICT that matched their needs." (ICT/IT manager)

"We have one example at our institution where a consultant had tested energy use and we are only now implementing it, it's automatic powerdown." (ICT/IT manager)

However, despite this, ICT and procurement managers still look for evidence of savings from other institutions before they are willing to invest in new technology. Finally, as green ICT initiatives are often ad-hoc and patchy it's impossible to accurately quantify where and how exactly any saving occurred.

"Stakeholders have expressed their lack of confidence in 'green ICT' to us i.e. they believe that new technology is not very green. Technology is greener (smaller, more energy-efficient) but as we use more of it from having 2–3 devices each, even though we are static in numbers of staff and students." (ICT/IT manager)

Respondents also added that ICT managers are often asked to demonstrate performance of any new equipment they may wish to purchase and justify their spend but energy consumption is not always included in the overall assessment.

"Green ICT does occur in certain areas, but it is patchy. One institution's data centre project felt they had done as much as they could do and taken it as far as it could have gone. Our institution is green and we participate in green ICT initiatives such as student blackout, Green Impact etc., but sustainability in general across campus is patchy. It depends on where you

go, for e.g. one department was excellent at switching everything off but then every desk had a desktop printer so they were not really being green." (ICT/IT manager)

Cuts in Funding.

Responses from participants in the interviews were similar to those of the main UK and Irish surveys, i.e. institutions were directly affected by the cuts in funding as they had their budgets slashed while other institutions did not have their budgets cut at all.

"No, it did not affect our budget, our budget remained the same." (Environmental/ Sustainability Manager)

"No to cuts in funding, we never had funding in the first place per se,, just the ICT 'essential ICT budget'. Sustainability is a personal incentive and it is something I would consider when refreshing the technology." (ICT/IT manager)

"No effects, no evidence of effect since the 2009 budget cut." (Environmental/ Sustainability Manager)

"No change to our original response, it is still the case. We were given a bit of a budget at the start of the year, and told to deliver our core business using it. If we buy newer 'green' kit and make savings – great –but we are really looking at technology on a Total Cost of Ownership (TCO) basis and will buy whatever works out cheapest. Incidentally, we do not have a greening officer." (ICT/IT manager)

Where institutions had their budgets cut, their sustainable performance was directly affected and implementation of any new greener ICT initiatives was never followed up on. This resulted in further energy wastage and ultimately unnecessary running costs.

"Since the recession, there has been more pressure to achieve savings which has made people more focussed on energy and carbon savings. If there is enough litigation by government, it helps with participation. Research into new technology and any technology that can clearly demonstrate savings and is showing a commercial advantage will be taken

on board and has been taken on board." (Environmental/ Sustainability Manager)

"Definitely, the cuts have had direct implications on sustainable projects. Before we had funding for sustainable projects but now money is only spent on the core business of servicing students and research. For e.g. our Head of the Computing Department wanted to implement automatic shutdown on PCs in the PC labs so he conducted some research into it, presented his findings at our environmental committee and engaged in lots of discussions. However, it is now 3 years later and nothing has been done about it. We still have not implemented automatic shutdown. Also, there has been no spending on national sustainable projects either such as Green Impact, because the finance department consider it unimportant." (ICT/IT manager)

"Yes, the cuts affected us a lot. There was no more funding to participate in JISC's Green ICT program. It was not just the lack of funding it was all the other stuff that went with it. There was no funding to attend workshops, the EAUC conferences or workshops etc. Green ICT is just one aspect of my job but if I had more JISC funding I could justify going to the EAUC conferences and workshops and feel enthusiastic about work again." (ICT/IT manager)

Institutional membership of a purchasing framework.

There was no real change in responses to the question regarding institutional membership of a purchasing framework. Comments and additional feedback included procurement teams being short-sighted and only looking at two- to three-year total life cost of ICT equipment and their current annual budget, with energy consumption rarely being a factor in the decision-making process.

"We use framework agreements, we don't have to but we've found them very helpful." (Environmental/ Sustainability Manager)

"*Our procurement team is short-sighted; it's all about this year and next year's budget. Unfortunately the senior managers never think past 2 years.*" *(Environmental/ Sustainability Manager)*

“There is no significant support from a framework or from procurement. Departments need to decide for themselves what technology they need and make a business case for its use. This is typically the middle managers job.” (Environmental/ Sustainability Manager)

“I work with our procurement staff when evaluating greener technologies. Some staff are very good but there is definitely a knowledge gap in procurement that needs to be bridged.” (ICT/IT manager)

However, other responses indicated that being part of a purchasing framework, or at least using their advice and guidance when purchasing, proved invaluable. The issue of there being a knowledge gap between sustainability and ICT was also addressed.

“No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT. However, some institutions were sceptical and wanted to see savings demonstrated first before they give permission to purchase greener technologies. They are now more conscientious of corporate responsibilities. The big issue now is the volume of data, and to be able to manage growth while at the same time bring real benefits too.” (ICT/IT manager)

“*Yes, we procured for our entire fleet of PCs. However, as behaviour changed, the procurement team started looking at power supply. Also, as the selection of types of PCs started to expand, we became more chosey and stricter about what we bought. In 1986, for example, energy was not an issue but then later on it became an issue. By the 2nd generation, 10–15 years later, (1995–2000) it became more of an issue*”. *(ICT/IT manager)*

Lacking Managers.

All of the respondents reiterated their previous answers in the main UK and Irish surveys with several more adding that they had become a little more aware of energy use since their ICT-related energy bills had been made part of their budgets and since responsibility to reduce costs was now within their remit. Another common thread in each of the interviews was that since departments

were managing their own budgets, staff numbers had been reduced to keep costs down and this added to staff's overall workload. As a result, an institution's sustainable performance was being undermined, instead of being considered an essential part of an institution's core business.

"*Yes our managers are lacking, lacking in knowledge as 'green' is not core business and therefore not considered important." (Environmental/Sustainability Manager)*

"The ICT manager's job was later taken away by librarians so really, ICT/ IT managers were lacking in lots of ways. In teaching and researching universities they need the best PCs and kit (for obvious reasons). The shift towards green ICT happened when energy became their problem. When it was decided that the cost of running PCs would come out of their budget that is when they decided to look at more energy-efficient kit. It's all about the budgets nowadays." (ICT/IT manager)

Students being regarded as paying customers who expect a certain level of service, namely 24/7 high-speed internet access (WiFi), was also a common thread in the responses. The "student experience" has become central to core business as it is part of an institution's selling point, especially to attract undergraduates. However, in order to keep profit margins wide, institutions are also looking at ways of reducing their running expenses and cutting back on support staff is one key area. This has become particularly popular as more and more ICT/IT services can be outsourced at a fraction of the cost.

"No change to customer service. We are still charging over £9k a year in tuition fees but are always looking at getting more funding for research and we are still, and always have been, looking at keeping costs down." (Environmental/Sustainability Manager)

"We have an unlimited budget for apps for anything student-related but the senior management team (SMT) never consider the staffing required to support it. It is getting worse! Staff members are becoming overworked and resentful. Our institution are looking at outsourcing ICT services more and

more as a way of saving money and as offsetting the issue of having to hire additional support staff." (ICT/IT manager)

"Our institution's appetite for WiFi is huge. The students' hunger for accessing content online is growing and is our main 'problem'. Our number of PCs stayed the same but what has grown is our increase in investment to support WiFi. As regards switching to greener technologies or noticing any shift in the way IT business is conducted, we have moved to server virtualisations." (ICT/IT manager)

However, CSR was mentioned as some students may refuse to attend an institution with a poor CSR reputation.

"A lot of sustainable ICT projects are just political moves by SMT whose main aim is keeping students happier. There is a slight leaning towards green as students expect to see a greener campus and better corporate social responsibility (CSR) so we are giving the 'clients' what they ask for. Yes, we are lacking in terms of being under-resourced in staffing for sure." (Environmental/Sustainability Manager)

"*My institution does not have a green ICT strategy or any kind of policy relating to how we can transform operations in an environmentally friendly way. Our ICT strategy should be a green ICT strategy, the two should be interlinked and not separate. As ICT is capital intensive, it demands a lot of initial investment costing millions so it makes sense to be sustainable and energy-efficient from the beginning. For example, there is not enough support for assistance with double-sided printing on one of the MFDs. There is a distinct lack of understanding of green ICT, of engagement in general and of coordination with the environmental team. In addition, staff are restricted as regards spending time on it. This disjointed/disconnected attitude is wrong, greening should be core business. Our managers are lacking by not having any knowledge of green technology, not so much new greener technology being purchased. Staff i.e. technicians and administrators are time poor and unless it is core business, they will not participate." (ICT/IT manager)*

"We do what we can do based on budgets and staff and resources." (Environmental/Sustainability Manager)

"Nowadays you need to show that your project is good for business and our institution is making it a requirement." (Environmental/Sustainability Manager)

Final comments about green ICT or sustainability in general.

A common thread was that while the number of students had not risen the types of technology being used by students had expanded to include smaller, mobile smart technologies. As such, the demand for faster connection and WiFi in every building was expected by those students. Known as the "improved student experience", it has become increasingly important to facilitate students in accessing the internet and webpages and networks quickly and confidentially 24/7. Researchers will always require the fastest most sophisticated computers. Server virtualisation was mentioned at least three times as being one of the more recent greener initiatives implemented. Failure on the part of senior managers at FHEs to realise that sustainability saves money and saving money equates to making money, was another common thread in both the main UK and Irish survey responses and in responses to the semi-structured survey. Even ICT/IT managers who are often more technically minded and whose core remit is to ensure technology is up and running 24/7, could see where false economies were happening.

Overworked staff was another common thread that came out of the survey and interview responses. This in turn leads to underperformance, which is likely to impact student experience and therefore core business. Failure on the part of senior managers to also realise that happier staff saves money longer term and saving money equates to making money. For a more detailed analysis of the semi structured interviews see Appendix XII.84 and XII.85.

5.52 Validity and Reliability of the Data.

Being able to provide data from more than one source to further evidence and support a phenomenon has been adopted to ensure the validity of the research data. Known as triangulation of evidence, it occurs when information is drawn from more

than one source and has become one of the most recognised and credible techniques for demonstrating validity and reliability in research (Gray, 2009). In each of the three stages of this research, data are taken from at least three sources: survey results (both preliminary and the main research survey), e-mails, case studies, reports and semi- structured interviews as evidenced in Chapters 4 and 5.

5.52.1 Threats to Reliability.

No response or partial response to a survey, is a fundamental problem that affects the validity and reliability of data. So too is asking the wrong questions or poorly wording them (Fowler, 2014). It indicates a failure on the part of the researcher to gather as much evidence as possible from those who are part of the sample (Aldridge and Levine, 2001, p.78). Only twenty-nine of the UK surveys were complete. A total of thirty-one out of sixty survey participants did not answer *all* of the questions. However, as there was a total of nineteen open-and close- ended questions, many of the thirty-one incomplete surveys were almost complete, with only one or two questions left unanswered. These incomplete surveys still provided useful qualitative and quantitative data. In the Irish survey, only ten surveys were completed fully and six were left incomplete. Similarly, many of the six incomplete surveys still provided useful data that contributed to the overall analysis of the results. The online survey tool SurveyMonkey categorised a survey as being incomplete if as few as one question was left unanswered. However, as the survey asked a range of questions targeted at a variety of FHE managers, certain questions would have been skipped as they may not have been considered relevant to the participant. Yet he/she continued the survey until the end. Denscombe (2010) believed that access, commitment, reliability, generalisation of the data and deception are the main disadvantages of the participant observation (Denscombe, 2010).

However, each of these threats were isolated in this investigation through triangulation and the robust design of each of the questionnaires.

5.52.2 Analysis of Comparison of each of the Datasets.

This chapter has reported the results of both the UK and Irish surveys that aimed at identifying barriers to participation in ICT projects in universities and colleges. It included an analysis of the responses of both surveys as well as three different

comparative analyses of the results of the surveys. Results of both surveys confirm the presence and absence of each of the seven barriers and highlight considerable overlap in many of the responses. They also highlight the disparity in many of the results, where, not only did barriers *not* exist in institutions, they were offered significant support in implementing the use of more sustainable technology and in engaging staff and students with sustainable behavioural change. In fact, when conducting the semi structured interviews, the researcher received many of the same responses to the questions as before and from both categories of managers .i.e. the data had reached saturation point. Finally, the datasets in section (i) and (ii) of this chapter are reliable, valid and are triangulated. They are reliable and are reproducible owing to the fact that if the same survey were carried out at a future date, the researcher is confident that the same results would be produced.

This data is also valid as each of the questions asked were worded correctly, in a direct manner, were circulated to various managers within the FHE sector and pertained to each of the possible barriers. Responses to the questions ultimately answered each of the research questions making the research valid. The data is also further triangulated as the results of the UK and Irish survey are similar and therefore support each other. The same too can be said of the results of the preliminary surveys carried out in Stage 1 of this research (as part of Year 1 of the UK SUSTE-TECH project) as many of their responses were the same as those of the UK and Irish survey.
The research sub-question – what are the key implications of those barriers - is also answered albeit to a lesser extent. Survey responses indicated what the implications of each of the barriers might be via the comments left in each of the surveys' comments section. A more detailed analysis of each of the responses to all questions is included in Appendix XII and the implications of the barriers are included in Chapter 7. In addition, the implications of the barriers were further shown in the responses to the semi-structured interviews (see section 5.52).

An overall conclusion of the research and the key implications of each of the barriers is included in Chapter 7. However, the second research sub-question – how can a sustainable ICT solution alleviate these barriers – still required answering. This sub-question question was answered in the creation of the Energy Detective web app which is discussed in detail in the next chapter, Chapter 6.

Chapter 6. The Energy Detectives Web App.

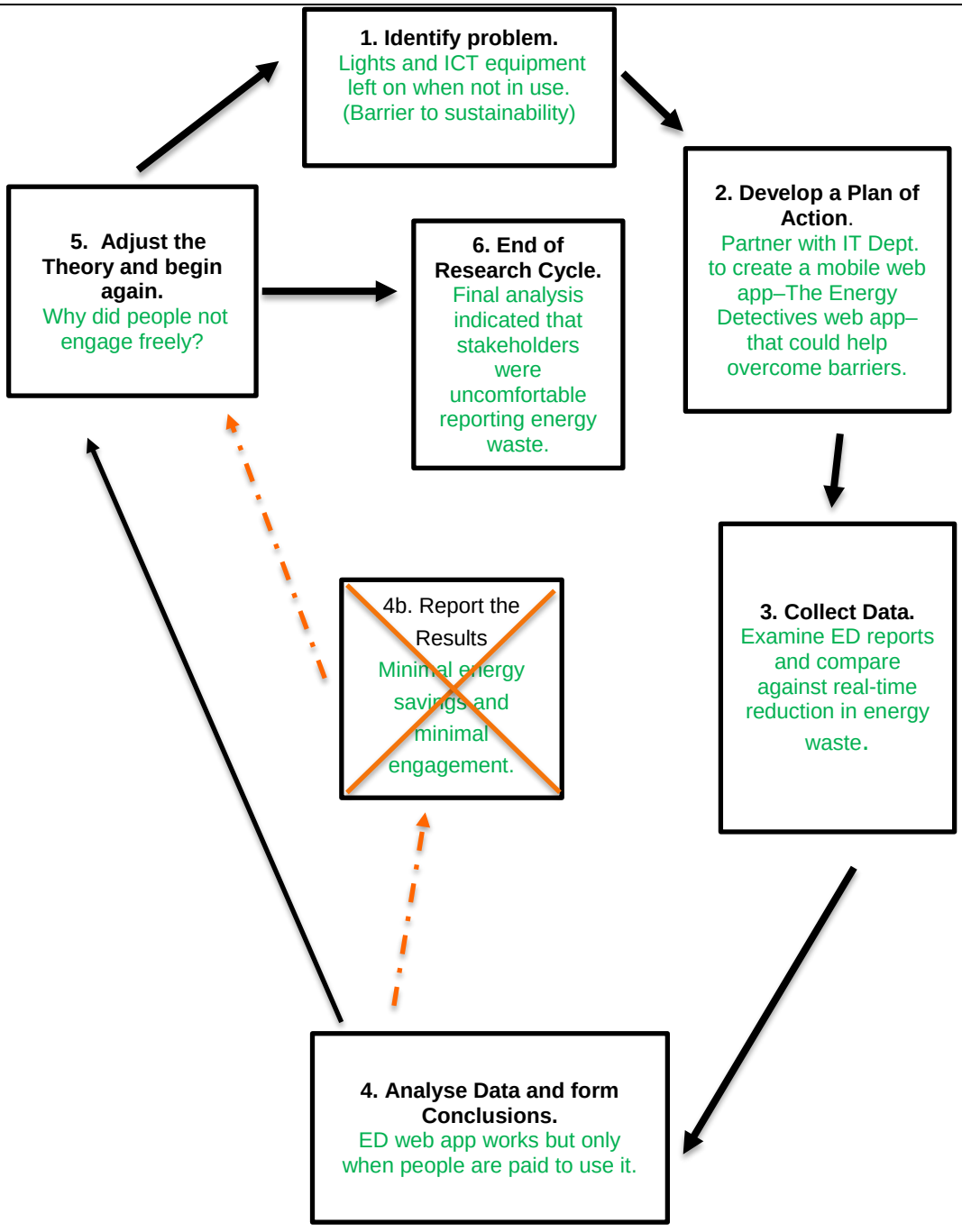
6.0 Introduction.

Having identified the gap in knowledge and having answered the research question the researcher set about bridging that gap. In doing so the second research sub-question – how can a sustainable ICT solution alleviate those barriers? – was answered. The gap in knowledge in this instance was identifying possible barriers to participation in sustainable ICT projects in UK and Irish universities and colleges and the solution to overcoming those barriers needed to be ICT-based. That ICT-based solution needed to engage with stakeholders, be a useful resource to lacking managers and help institutions overcome cuts in funding while at the same time being convenient and easy to use and cost-free to the user. In short, it needed to overcome all or at least some of the seven barriers identified. From these criteria, the Energy Detectives (ED) mobile web app was created. In its creation and implementation, the cycle of action research at Goldsmiths, University of London was taking place, which was the third and final stage of this research (See Chapter 3, section 3.6.4.1 for more details on action research). Figure 6.1 illustrates the flow of action research and how it pertains to the creation and implementation of the Energy Detectives web app. However, action research occurs in more than just one cycle. This chapter includes the adjustments of the use of the Energy Detective web app that ultimately highlighted the difficulties in bringing about social change at Goldsmiths. The interventions are presented in this chapter in order of their occurrence and the key learning objectives gained from each of the interventions is discussed.

6.1 The Researcher's Role Goldsmiths, University of London.

The researcher was employed as the Space, Environmental and Sustainable (SES) Officer at Goldsmiths, University of London at the time of completion of this study, and the remit was extremely broad. It included many individual but interconnected environmental initiatives including the examination of rates of recycling, participation in Green Impact, embedding Fairtrade at Goldsmiths, being the secretary for the Environmental and Sustainable Working Group (ESWG) and the Space Management Working Group (SMWRG) amongst other responsibilities. The SES officer also examined sustainable procurement, student engagement and

the efficient management of teaching spaces, as well as managing initiatives that targeted a reduction in energy use. She had first-hand experience in the difficulties in engaging with stakeholders to change their behaviour from one of being wasteful to being sustainable, which put her in the unique position to introduce the required interventions that would ultimately bring about social change via action research.



The coloured text relates to the actions of the researcher.

Figure 6.1 is an amended version of Kolk's (2016) illustration of the cycle of action research.

Figure 6.1 Action Research Using The Energy Detectives Web App.

6.1.1 Energy Management at Goldsmiths.

The first stage of the action research cycle involved identifying the problem of barriers and limiting factors to implementing greener ICT at Goldsmiths campus. In this instance it pertained to stakeholders leaving lights and ICT equipment on unnecessarily thereby creating energy waste. From 2009 to 2016 the Estates and Facilities department at Goldsmiths saved an estimated £650,000 on energy running costs and reduced their CO_2 emissions by 10%. These savings were mainly due to their energy RE:FIT Project, a combination of the replacement of old inefficient heating systems with the upgrading and repairing of existing infrastructure. However, energy was still being wasted across campus. Lights, ICT equipment and other electronic equipment in lecture theatres and studios were not being switched off after use, despite signage being in place requesting users to do so (see Figures 6.2a and 6.2b, Figure 6.3a and 6.3b and Figure 6.4a and 6.4b). Goldsmiths' aim of reducing this type of ICT-related energy waste was essentially the same as that of the UK SUSTE-TECH and Scotland Sustainable ICT projects so the SES officer (the researcher) predicted that Goldsmiths was likely to face the same barriers in implementation as had been experienced in those projects. Armed with that knowledge, the Energy Detectives project was designed with overcoming each of the seven barriers in mind.

Figure 6.2a Standard instruction for switching off lights.

Figure 6.2b Standard instruction for switching off lights.

Figure 6.3a Standard instruction for switching off PCs and Macs.

Figure 6.3b Standard instruction for switching off PCs and Macs.

The sign posted on the teaching lectern reads Stop: Have you finished using this room? If so, please SWITCH OFF PROJECTOR BY PRESSING “OFF” BUTTON.

The message on the Mac invites the user to put the ICT device to sleep after a period of inactivity thereby saving energy.

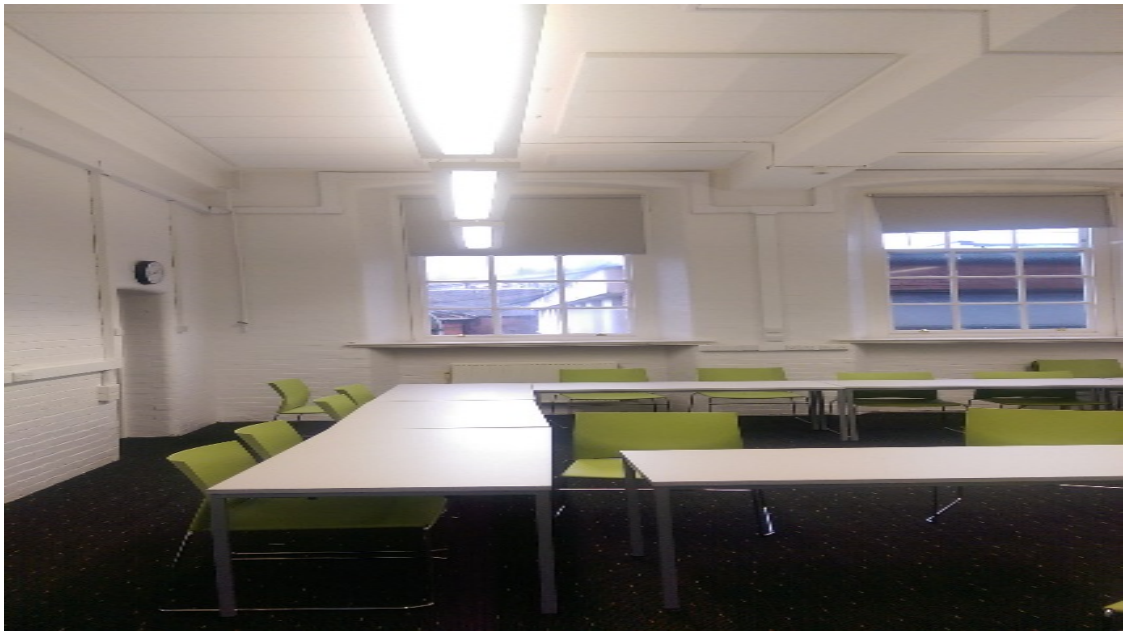


Figure 6.4a Examples of lights left on in empty classrooms and studios.

Figure 6.4b Examples of lights left on in empty classrooms and studios.

6.2 The Energy Detectives Web App.

6.2.1 Creation of the Energy Detectives Web App.

The second stage of the action research cycle involved developing a plan of action that included the creation of an ICT solution that would overcome all or some of the barriers. Development of such a solution would also answer the second research sub-question, "*how can a sustainable ICT solution alleviate those barriers?"* Central to the second stage of the action research cycle developing a plan of action, the researcher partnered with Goldsmiths IT Dept. and created the mobile web app, The Energy Detectives web app (see Appendix X). At the design stage it was agreed that the web app needed to engage with stakeholders, be a useful resource to lacking managers and help institutions overcome cuts in funding while at the same time be convenient and easy to use and cost-free to the user. It made sense therefore to create a web app as opposed to a regular smartphone app as they proved to be prohibitively expensive.

6.2.2 How the Energy Detective Web App works.

The Energy Detectives web app is essentially a webpage that allows staff and students at Goldsmiths, University of London to report where and when they see energy being wasted across campus. It is accessed via a smartphone, by typing edetect.gold.ac.uk into the Goldsmiths homepage's browser and registering the users login details. Users of the web app need to also be connected to the Goldsmiths Eduroam, which is a type of wifi exclusive to universities. Once logged into the Energy Detectives webpage, a drop-down menu of the list of buildings on Goldsmiths campus along with the type of wastage occurring appears and users can make their choices accordingly. Users can also take a picture of the classrooms or spaces where energy is being wasted as further evidence. Users of the web app, were also asked to prevent further wastage by switching off whichever category of energy waste they saw occuring. All energy wastage reported was stored on a central server that is accessed by the researcher to monitor the data and frequency of reports (see Figure 6.5 and Appendix VIII.1 to VIII.3) Everyone who used the Energy Detectives web app to record energy wastage was automatically entered into a draw to win a £20 gift voucher of their choice (see Appendix XVI.1 to XVI.4).

Once the ED web app was up and running the SES officer started to collect data pertaining to ICT and light energy waste across Goldsmiths campus. This essentially was the start of the third stage of the action research cycle. The SES officer examined the ED reports and compared them against real-time reduction in energy waste. The project commenced in November 2015 and is still in operation in 2017 on completion of this thesis. However, for the purpose of this chapter, the energy use of certain rooms in specific buildings and at specific times during the months of January 2016 to April 2016 is examined. This is to demonstrate how any reduction in energy use after 5pm can be attributed to the Space Enhancement Officers (SEOs) also known as Energy Detectives. This team of five students spent their evenings switching lights and ICT equipment off once they had recorded the energy wastage. Figures 6.6a and 6.6b are from Goldsmiths NoWatt Energy Management website and indicate the reductions in energy use in classrooms that occurred as a result of the SEOs switching off lights and ICT equipment.

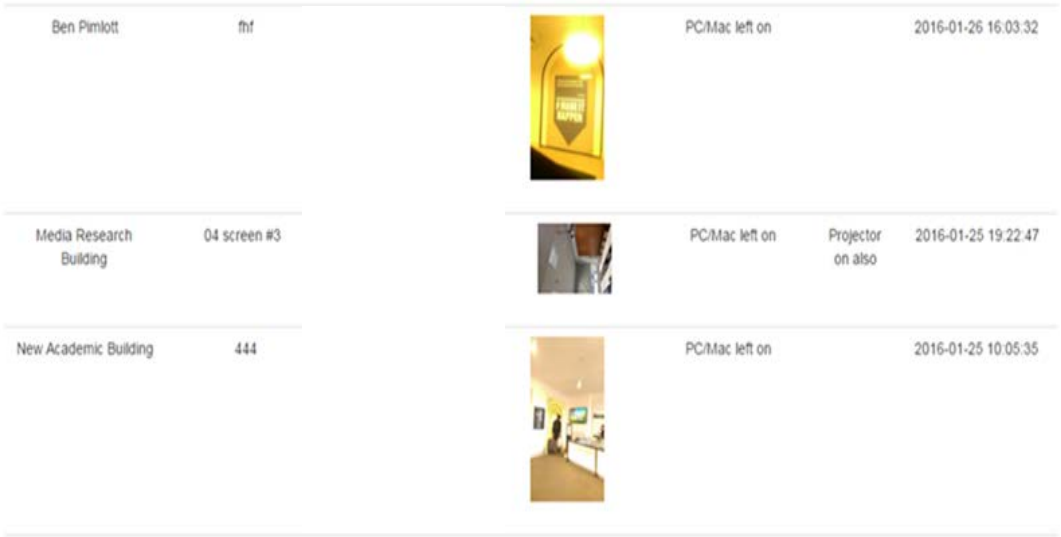


Figure 6.5 Screenshot of Energy Detectives Account.

Table 6.0 Information contained in the Energy Detectives Account.

Building	Room ID	Name of ED	Image	Details	Comments	Timestamp
Ben Pimlott	fhf	x.xxx@gold.ac.uk	x	PC Mac left on		2016-01-26 16:03:32
Media Research Building	04 screen#3	y.yyy@gold.ac.uk	x	PC/Mac left on	Projector also left on.	2016-01-25 19:22:47
St James Church	444	a.zzz@gold.ac.uk	x	PC/Mac left on		2016-01-25 10:05:35

6.2.3 The Role of the Space Enhancement Officers (SEOs).

The Space Enhancement Officers (SEO's) are a team of students hired by the Estates and Facilities department to conduct room checks each evening. Their main remit is to check that ICT equipment in teaching rooms is in working order and furnishings are not in need of repair. In January, of 2016, SEOs were asked by the SES officer (the researcher) to start reporting energy wastage from ICT equipment and lighting left on when not in use using the Energy Detective web app on their smartphones (Appendices VII.1–VII.3). Each lCT lectern was clearly labelled to switch off ICT equipment after use (see Figure 6.3a and 6.3b), as were light switches (see Figure 6.2a and 6.2b).

It was only through a series of face-to-face meetings with each of the five SEOs that a substantial amount of qualitative data was obtained. The fact that the SEOs were being paid to conduct room checks was crucial to the success of the researcher being able to gather such a large amount of quantitative data. The Energy Detectives project can be considered a sustainable ICT project in its own right. ICT waste is being tackled through the reporting and subsequent switch-off of ICT equipment when not in use. While it is not a clear "before and after" comparison of ICT energy use like many of the JISC Greening of ICT projects, the ED project identified energy wastage across campus and ultimately helped to reduce it.

Figure 6.5 and Table 6.0 above show the information contained in the Energy Detectives web app report which was checked by the SES officer throughout this research. It shows for which buildings the reports of energy waste were made, at what time and exactly what type of energy was being wasted. It shows an image of the energy being wasted as further evidence of where and when the wastage

occurred and any comments the SEOs or Energy Detectives might have made. Examples of energy savings made as a result of engaging with the ED web app are illustrated in images 6.6 to 6.8.

6.2.4 Examples of the Energy Detective Web App in Use.

The first example shows the energy use of the Ben Pimlott Building (BPB) on January 26 2016. Figure 6.6a and Table 6.0 shows the energy consumption reading for that day at 16:02 being 47kWhrs according to Goldsmiths NOWatt energy monitoring software. The SEOs/EDs reported energy being wasted via the ED web app at 16.03.32 (see first reading in ED web app report table) and switched the lights and ICT equipment off at that time. This was immediately followed by a drop in energy use of 3 kWhrs. By 16.03, one minute later, the No Watt reading was just 44 kWhrs (see Figure 6.6b). This indicated that the savings of 3kWh of energy use were created by the SEOs/EDs making the switch-off. Two more examples of energy savings, one in the Media Research Building (MRB) and one in the New Academic Building (NAB) (renamed the Professor Stuart Hall Building in 2014) are given in Figure 6.7 and 6.8.

1. The Ben Pimlott Building (BPB).

The energy consumption readings of the First Floor Kitchen, First Floor Lab and First Floor Studio reduce by one, two and one kWh respectively once the 16:03 switch-off was made (see Figure 6.6b).

Figure 6.6a Energy Consumption Reading for BPB on January 26th, 2016 at 16:02.

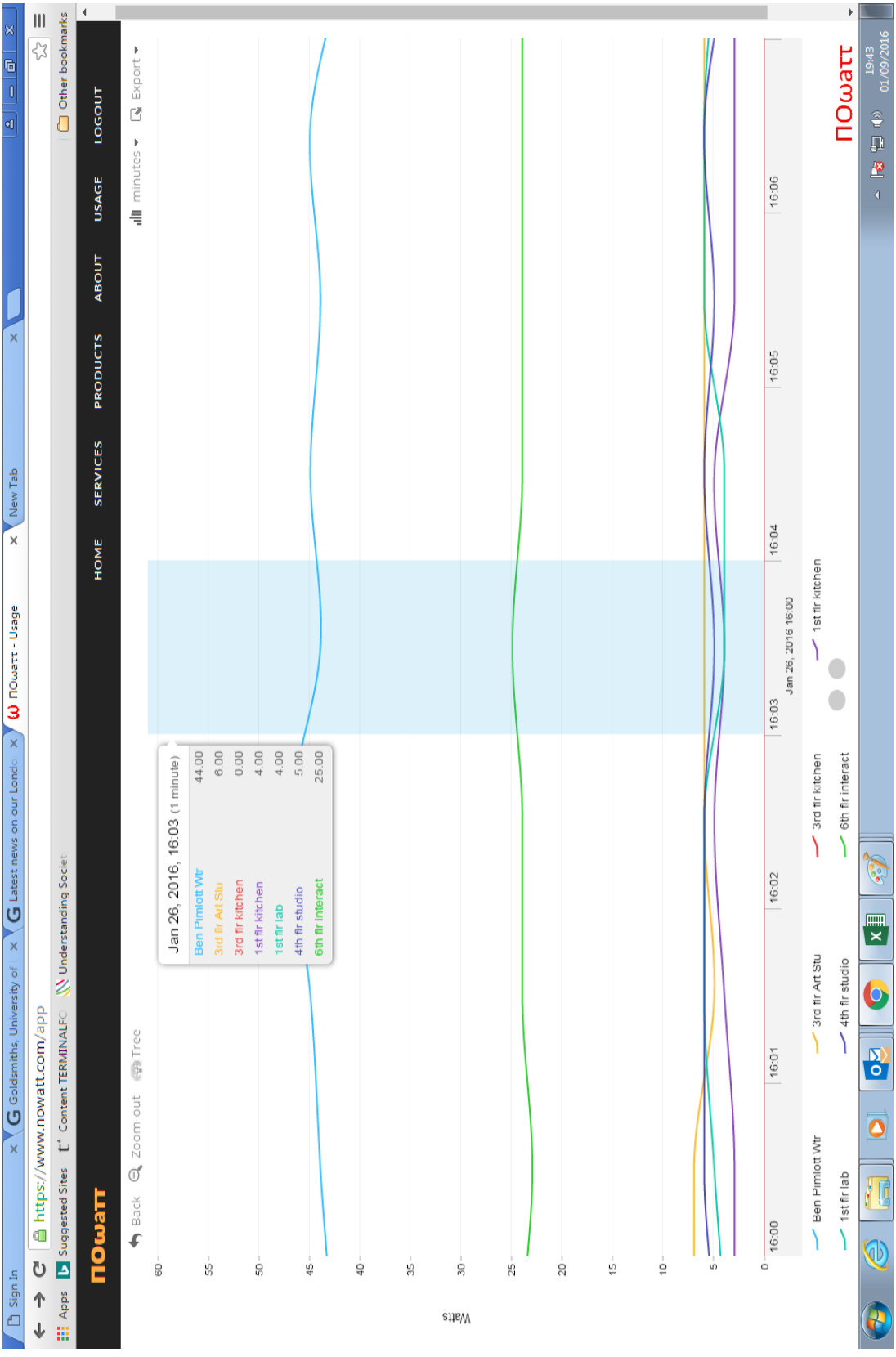


Figure 6.6b Energy Consumption reading for BPB on January 26, 2016 at 16:03

2. The Media Research Building (MRB).

On **January 25th, 2016 at 19:21:00**, the energy use reading in the MRB was 27,411.78 kWh (see Figure 6.7a). By 19:22:47 the energy reading was reduced to 24,927.07 kWh, a reduction of 2,484.71kWh or 9% (See Figure 6.7b). This is due to the SEO (energy detective) switching off the energy waste, which in this case was ICT equipment as this is what was reported on the ED web app (see Figure 6.5 and Table 6.0).

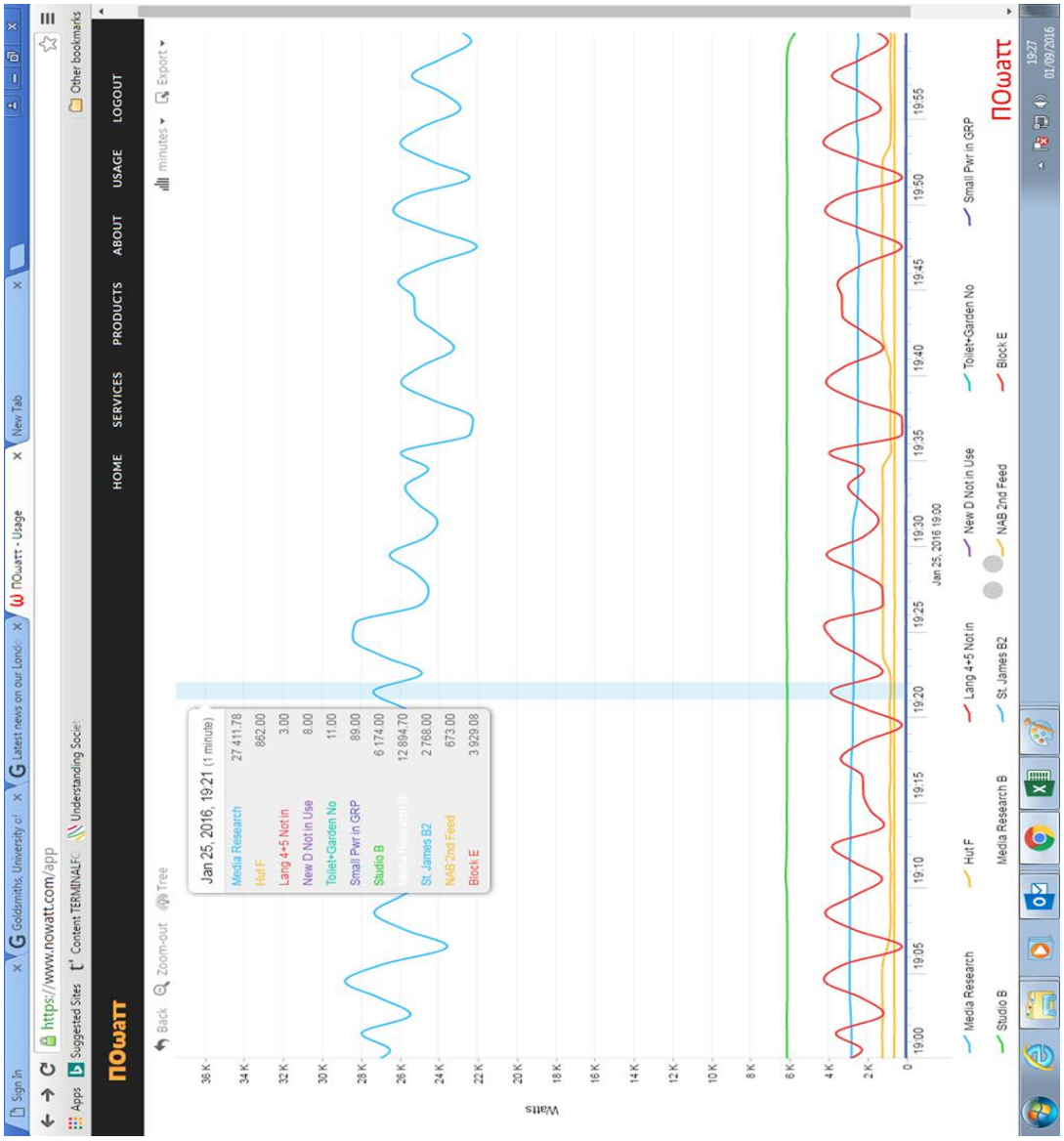


Figure 6.7a Energy Consumption Reading in the MRB on January 25th, 2016 at 19:21.

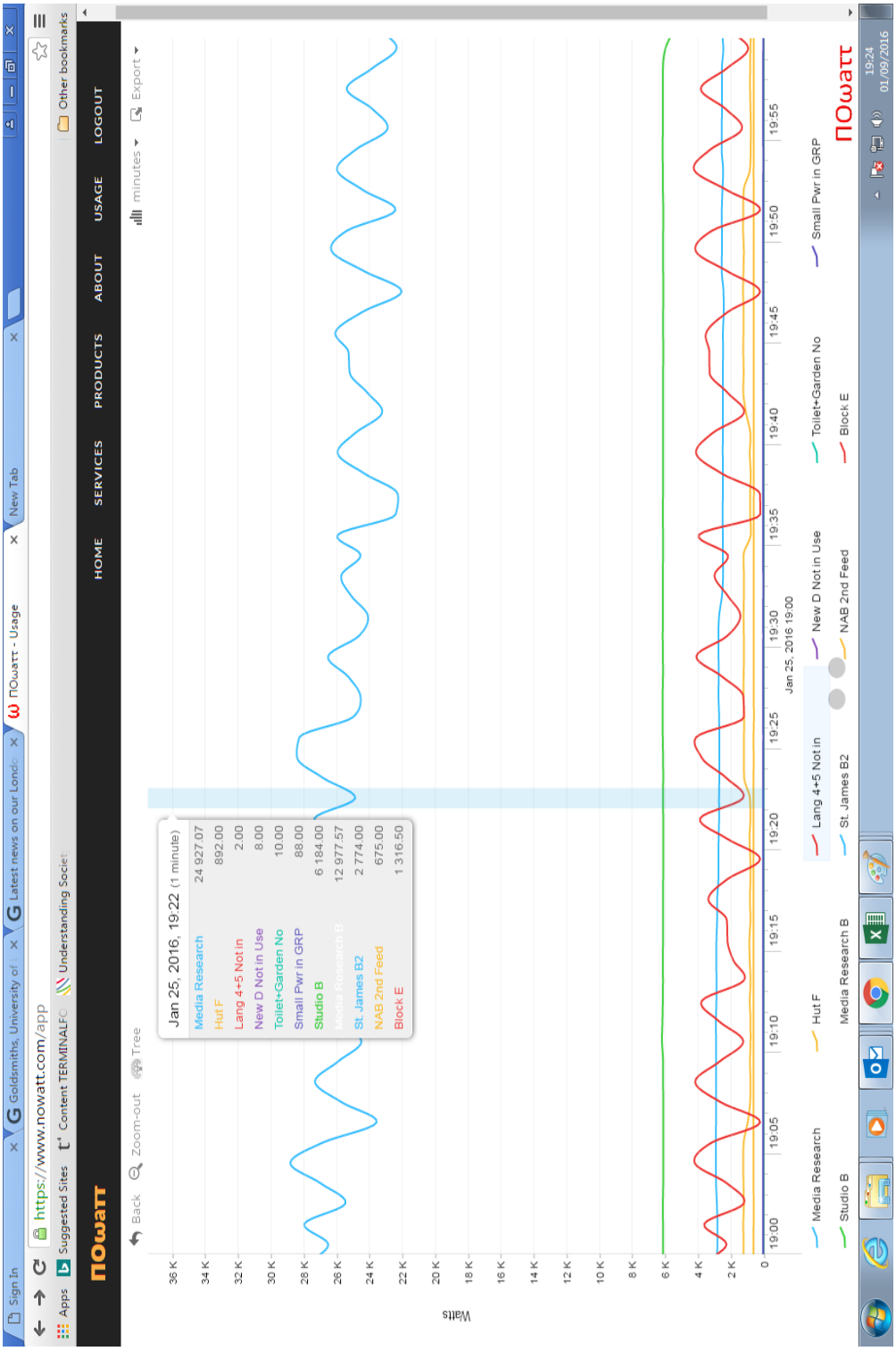


Figure 6.7b Energy Consumption Reading in the MRB on January 25th, 2016 at 19:22.

3. The New Academic Building (NAB), January 25th 2016 10:04 and 10:05.

On January 25th 2016 at 10:04 energy use in the NAB read 672 Watts (see Figure 6.8a). One minute later, at 10:05, after the SEO/Energy Detectives switched off the energy waste, the energy consumption reduced to 666 Watts (See figure 6.8b). This coincided with the time at which the SEO/ED switched off the PC/MAC that's was left on.

Figure 6.8a New Academic Building January 25th, 2016 10:04:00.

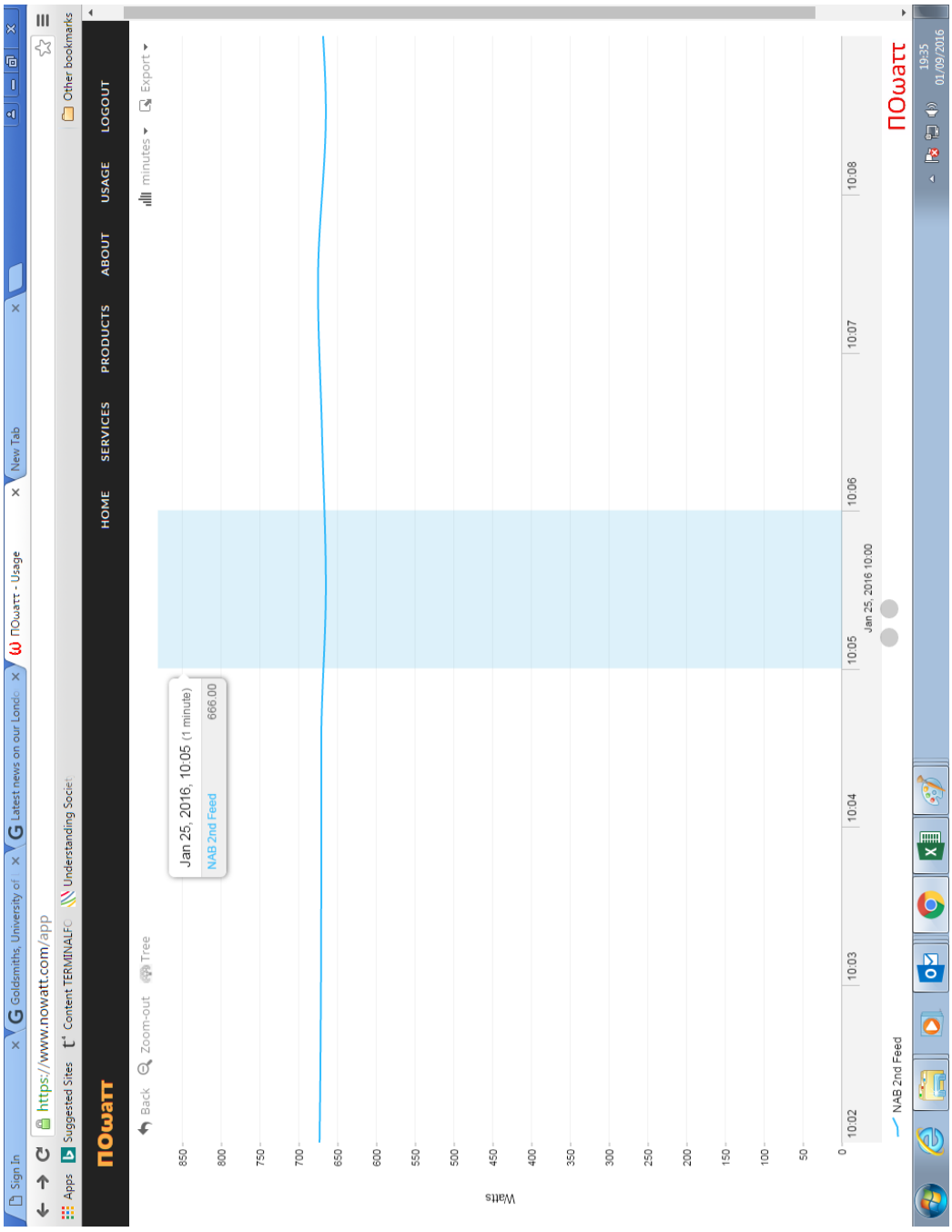


Figure 6.8b New Academic Building January 25th, 2016 10:05:00

In keeping with the **third stage** of the **action research cycle** data was collected to evidence if a reduction in energy waste occurred.

6.2.5 Reporting of Energy Wastage.

From January to April 2016 a total over 305 incidences of energy wastage were reported, highlighting specific times, dates and locations across campus where ICT equipment and lights were left on, and then switched off by SEOs. Table 6.1 and Appendices VIII–X show the format of how the Energy Detectives web app reports waste energy.

Table 6.1 The Reporting Format of the Energy Detectives Web App showing Reports of Energy Wastage.

Building	Room ID	Image	Details	Comments	Timestamp
Education Building	212	x	Lights left on		2016-01-18 10:57:02
New Academic Building	203	x	PC/Mac left on	Light Left on also	2015-10-02 09:36:19
St James Church	111	x	PC/Mac left on	Lights also left on	2015-12-07 15:30:34
Barridale Building B	(Studio B)	x	PC/Mac left on	Lights also left on	2016-01-14 14:23:46

6.3 Cost and Carbon Savings via the Energy Detective Web App.

The research examined reports of energy being wasted over the same four-month period, from January to April 2016. In total 305 incidents of energy being wasted were reported and actioned (lights and ICT equipment switched off at the time of reporting), preventing a further 3,522 hours of ICT and lighting energy being wasted. This number equated to savings of approximately £370 and a reduction of 1.02 tonnes of CO_2. These savings were calculated by multiplying the time the switch-off was recorded via the ED web app until 8am the following day. Those numbers of hours, typically between thirteen and fifteen hours per classroom, were then multiplied by the average energy requirement of each piece of ICT equipment and light (varied from room to room and between pieces of ICT equipment) and multiplied again by the cost per kWh of energy (0.104p per kWh hour).

For e.g., the average PC and Mac energy requirement when idle is 75.5 kWhrs so this was multiplied by the number of hours the energy was being wasted (13–18 hours) by the cost per kWh of energy (0.104p per kWh hour). The total amount of energy saved by ICT (PCs/Macs) being switched off from January until April amounted to £8.74, a minimal amount. However, examining the average lighting consumption across campus (650W or 0.65kW) varied greatly as there are a multitude of different types of lights and number of bulbs per light fitting in each room in various buildings. Calculations estimated that from January 2016 to April 2016 approximately £162.00 was saved by SEOs switching lights off. In addition, a total 622.kgs of CO_2 was saved from lights not being left on and 135 kgs of CO_2 from PCs/Macs not left running. Total savings amounted to approximately £190. Carbon emissions were calculated using the Carbon Conversion Factor of 0.40957 as given by the DECC (DECC, 2016). Table 6.2 is an example of how the findings were arrived at.

Table 6.2 Calculation of Cost and Carbon Savings via the use of the ED Web App.

Building and Room Number.	Timestamp.	Incident.	Energy requirement of device.	Saving (hrs) made due to switch-off (Time of switch-off to 9am the following morning).	Cost of energy (per kWh).	Amount in Savings (£).	Kgs of CO_2 emissions (using the Carbon Conversion
RHB 144	10/01/2016 18:04:09	Lights left on	0.65 kW	15:55:51	(.10414p)	£1.05p	.43
RHB143	11/02/2016 18:12:50	PC/Mac left on	0.0755kW	13:47:10	(.101414p)	£1.20p	.042
Education Building Room 212	02/03/2016 19:01:09	PC/Mac left on	0.0755 kW	12:58:51	(.101414p)	£1.20p	.038
Education Building Room 109	27/04/2016 20:26:32	Lights left on	0.65 kW	11:33:28	(.101414p)	£.71p	.370

Reduction in energy waste created through engagement with the Energy Detectives project is further evidenced by examining the energy bills of individual buildings across campus. One group of buildings where the SEOs frequently recorded energy waste using the ED web app was 30–43 Lewisham Way, a row of Victorian-era houses refurbished as offices. The financial costs associated with the energy consumption of each building on a monthly basis from October 2015 to April 2016 are summarised in Table 6.3.

Table 6.3 Financial Costs of Energy Use in Lewisham Way Offices from September 2015 to April 2016.

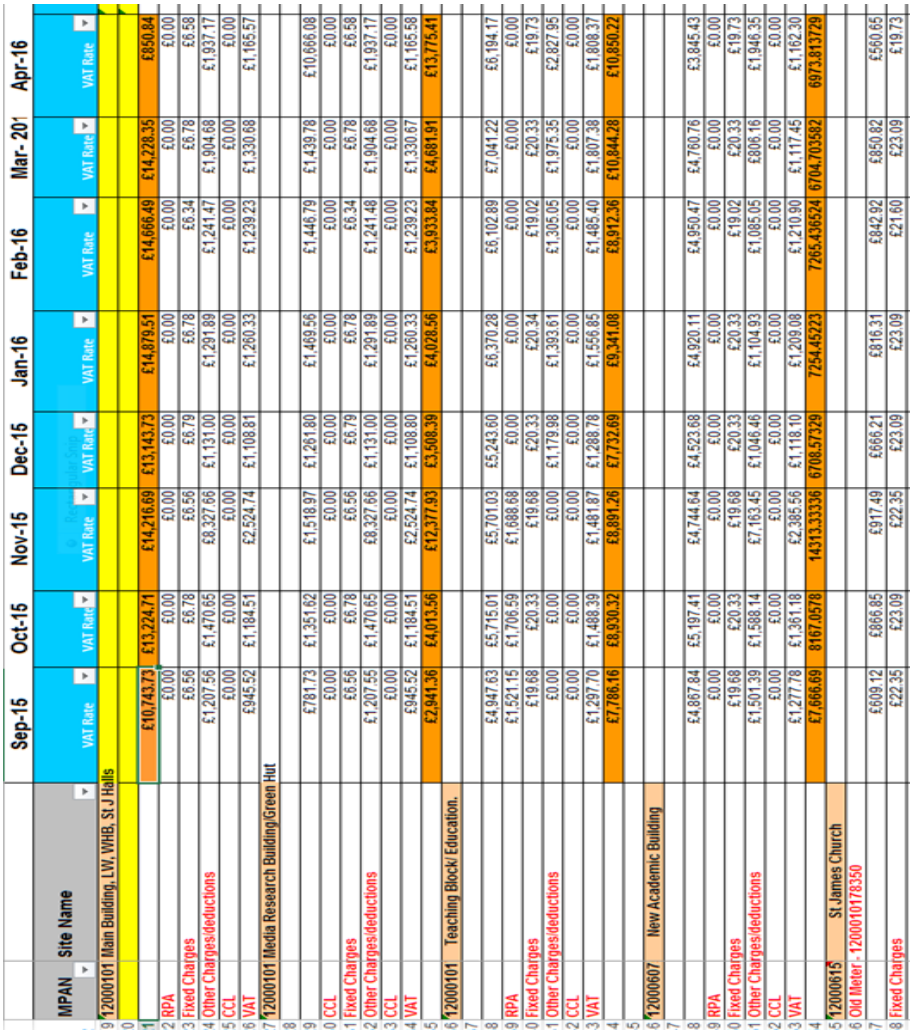
Office on Lewisham Way	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	April 2016
30	£537.54	£389.93	£376.18	£452.06	£444.88 *	£357.48 *	£165.68 *
34	£336.62	£185.62	£208.20	£281.20	£211.92 *	-------- No data	-------- No data
41	£63.89	£58.44	£56.51	£93.47	£64.94 *	£66.37 *	-------- No data
43	£77.97	£17.16	£22.68	£17.06	£19.87	£66.07	-------- No data

Data in Table 6.3 with asterix * indicates decreases in the financial cost of energy use in certain Lewisham Way buildings from its previous month. Additional evidence of energy use reduction via reduced energy bills is summarised in Table 6.4.

Table 6.4 Financial Costs of Energy Use in Campus Buildings from November 2015 to April 2016.

Location	**November 2015**	**December 2015**	**January 2016**	**February 2016**	**March 2016**	**April 2016**
Main Building, LW, WHB, St James Halls.	£14,216.69	£13,143.73	£14,879.51	£14,666.49*	£14,228.35*	£850.84*
Media Research Building and Huts.	£12,377.93	£3,508.39	£4,028.56	£3,933.84	£4,681.91	£13,775.41

Teaching Block/ Education	£8,891.26	£7,732.69*	£9,341.08	£8,912.36*	£10,844.28	£10,850.22
New Academic Building.	£14,313.33	£6,708.57*	£7,254.45	£7,265.44	£6,704.70*	£6,973.81
St James Church.	£1,347.42	£1,055.60	£1,233.83	£1,248.34	£1,274.23	£1,184.59*



MPAN	Site Name	Sep-15		Oct-15		Nov-15		Dec-15		Jan-16		Feb-16		Mar- 201		Apr-16	
		VAT Rate		VAT Rate		VAT Rate		VAT Rate		VAT Rate		VAT Rate		VAT Rate		VAT Rate	
12000101	Main Building, LW, WHB, St J Halls																
		£10,743.73		£13,224.71		£14,216.69		£13,143.73		£14,879.51		£14,666.49		£14,228.35		£850.84	
RPA		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00	
Fixed Charges		£6.56		£6.78		£6.56		£6.79		£6.78		£6.34		£6.78		£6.58	
Other Charges/deductions		£1,207.56		£1,470.65		£8,327.66		£1,131.00		£1,291.89		£1,241.47		£1,904.68		£1,937.17	
CCL		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00	
VAT		£945.52		£1,184.51		£2,524.74		£1,108.81		£1,260.33		£1,239.23		£1,330.68		£1,165.57	
12000101	Media Research Building/Green Hut																
		£781.73		£1,351.62		£1,518.97		£1,261.80		£1,469.56		£1,446.79		£1,439.78		£10,666.08	
CCL		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00	
Fixed Charges		£6.56		£6.78		£6.56		£6.79		£6.78		£6.34		£6.78		£6.58	
Other Charges/deductions		£1,207.55		£1,470.65		£8,327.66		£1,131.00		£1,291.89		£1,241.48		£1,904.68		£1,937.17	
CCL		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00	
VAT		£945.52		£1,184.51		£2,524.74		£1,108.80		£1,260.33		£1,239.23		£1,330.67		£1,165.58	
12000101	Teaching Block/ Education.	£2,941.36		£4,013.56		£12,377.93		£3,508.39		£4,028.56		£3,933.84		£4,681.91		£13,775.41	
		£4,947.63		£5,715.01		£5,701.03		£5,243.60		£6,370.28		£6,102.89		£7,041.22		£6,194.17	
RPA		£1,521.15		£1,706.59		£1,688.68		£0.00		£0.00		£0.00		£0.00		£0.00	
Fixed Charges		£19.68		£20.33		£19.68		£20.33		£20.34		£19.02		£20.33		£19.73	
Other Charges/deductions		£0.00		£0.00		£0.00		£1,179.98		£1,393.61		£1,305.05		£1,975.35		£2,827.95	
CCL		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00	
VAT		£1,297.70		£1,488.39		£1,481.87		£1,288.78		£1,556.85		£1,485.40		£1,807.38		£1,808.37	
		£7,786.16		£8,930.32		£8,891.26		£7,732.69		£9,341.08		£8,912.36		£10,844.28		£10,850.22	
12000607	New Academic Building																
		£4,867.84		£5,197.41		£4,744.64		£4,523.68		£4,920.11		£4,950.47		£4,760.76		£3,845.43	
RPA		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00	
Fixed Charges		£19.68		£20.33		£19.68		£20.33		£20.33		£19.02		£20.33		£19.73	
Other Charges/deductions		£1,501.39		£1,588.14		£7,163.45		£1,046.46		£1,104.93		£1,085.05		£806.16		£1,946.35	
CCL		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00		£0.00	
VAT		£1,277.78		£1,361.18		£2,385.56		£1,118.10		£1,209.08		£1,210.90		£1,117.45		£1,162.30	
		£7,666.69		8167.0578		14313.33336		6708.57329		7254.45223		7265.436524		6704.703582		6973.813729	
12000615	St James Church																
Old Meter - 1200010178350																	
		£609.12		£866.85		£917.49		£666.21		£816.31		£842.92		£850.82		£560.65	
Fixed Charges		£22.35		£23.09		£22.35		£23.09		£23.09		£21.60		£23.09		£19.73	

Figure 6.9 Screen Shot of Financial Costs associated with Energy Use in Campus Buildings from September 2015 to April 2016 indicating fluctuating energy consumption across campus.

The fourth stage of the action research cycle involved analysing the data and forming conclusions. In doing so, any real costs and carbon savings created as a result of engagement with the ED project were determined. This would ultimately prove whether the ED web app worked or not i.e. did it prove to be an effective ICT solution for overcoming the barriers. After closer examination of specific and general energy savings at Goldsmiths, the researcher concluded that the ED web app worked. It proved to be an effective ICT solution for overcoming the barriers, namely poor stakeholder engagement, lacking managers and cuts in funding. A detailed look at an analysis of the ED data gathered is given in the following section, section 6.4.

6.4 Energy Consumption Patterns at Goldsmiths.

While specific examples of energy reduction using the Energy Detectives web app from January to April 2016 exist, Tables 6.3 and 6.4 and Figures 6.9 also indicate fluctuating energy consumption across campus. Energy consumption across campus varies from month to month and from building to building. Figure 6.10 is an example of a selection of Goldsmiths' buildings' (the RHB, the SU and the BPB) energy use in 2015 compared to that of 2016, indicating a continuous and clear reduction in energy use. However, the same images and tables also indicate that reduction in energy use is intermittent with no continuous pattern of annual energy reduction during the months of January 2016 to April 2016 in any of the buildings, or even when comparing overall annual energy use.

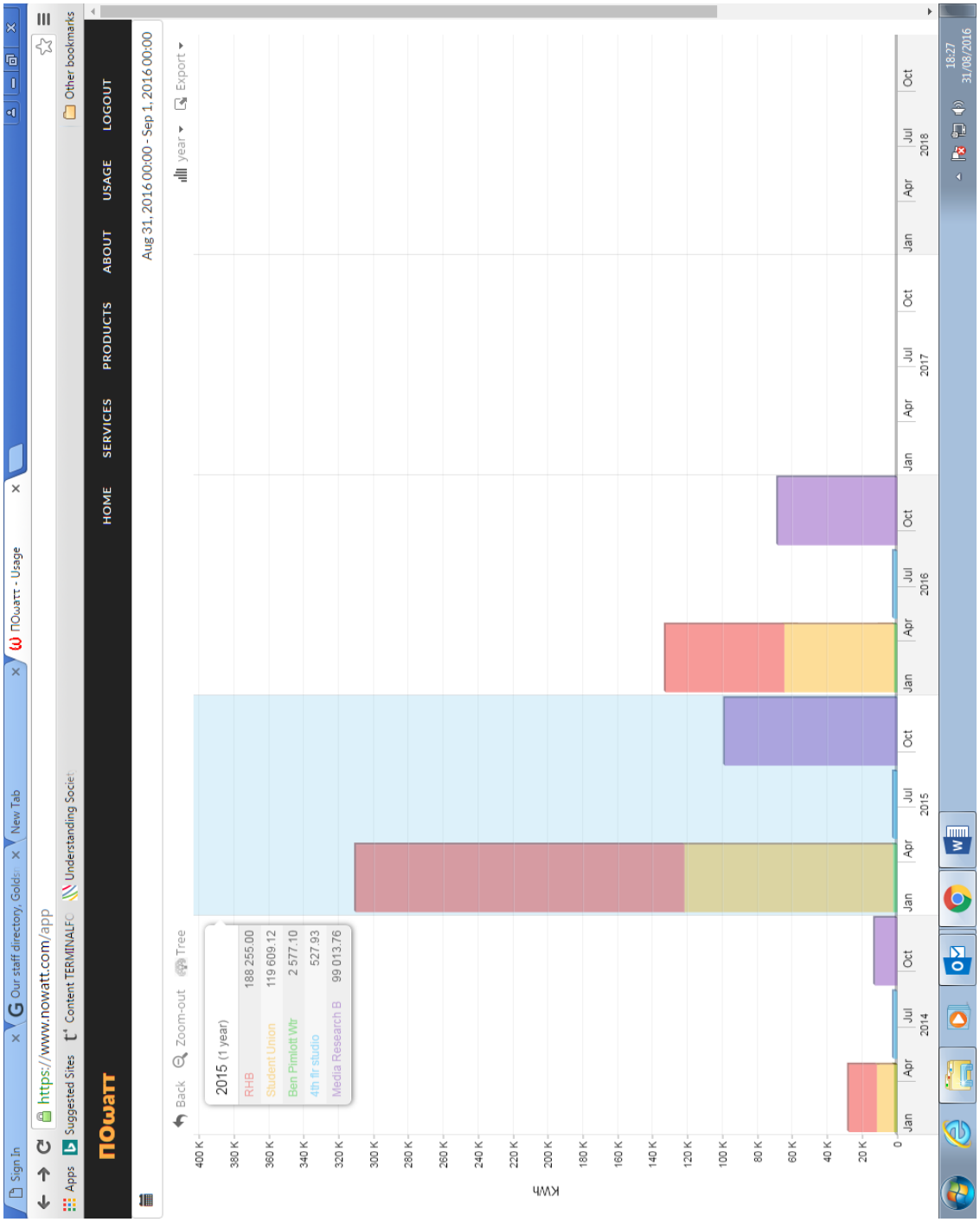


Figure 6.10 Comparison of 2015 Energy use of Goldsmiths Buildings with 2016 Energy Use.

Trends in energy use in some buildings for example the Ben Pimlott and the Richard Hoggart Building, can be identified on a month-by-month basis (see Figure 6.11 and 6.12). However, as these building do not have energy meters installed in individual classrooms it was not possible to accurately pinpoint where and how the energy reduction occurred. It can only be assumed that any reduction in energy waste is due to staff engaging with the Energy Detectives project. The Building Management Systems (BMS) across campus are such that they measure the energy use of water heaters, gas and oil boilers and solar panels that service more than one building, making it impossible to clearly pinpoint which of these buildings are responsible for any reduction or increase in energy use.

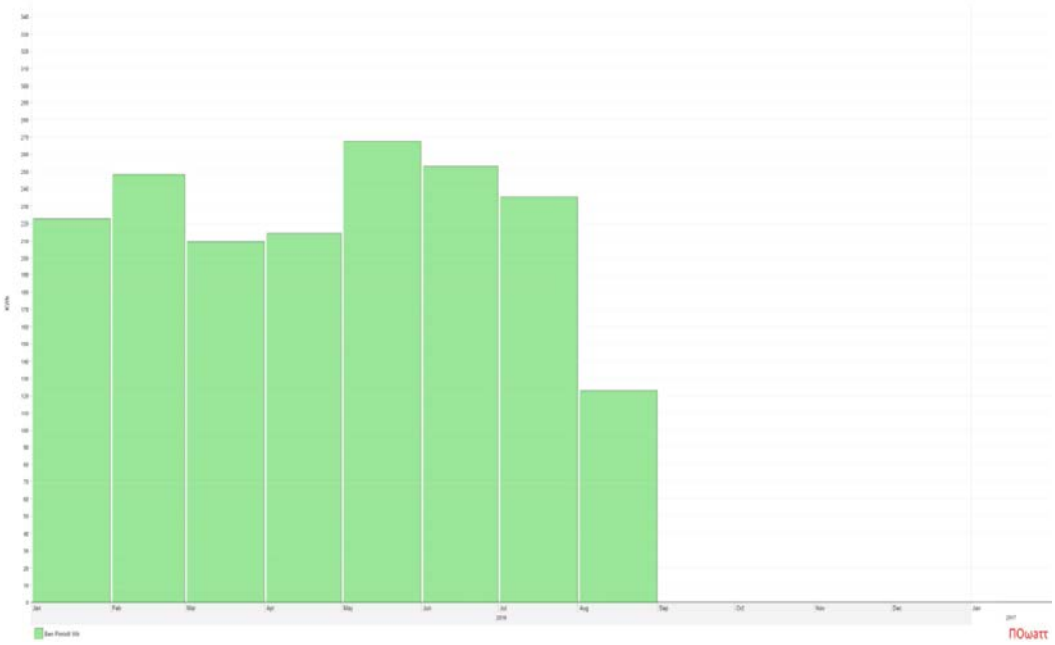


Figure 6.11 Example of Fluctuating Energy use in the Ben Pimlott Building from January to April 2016.

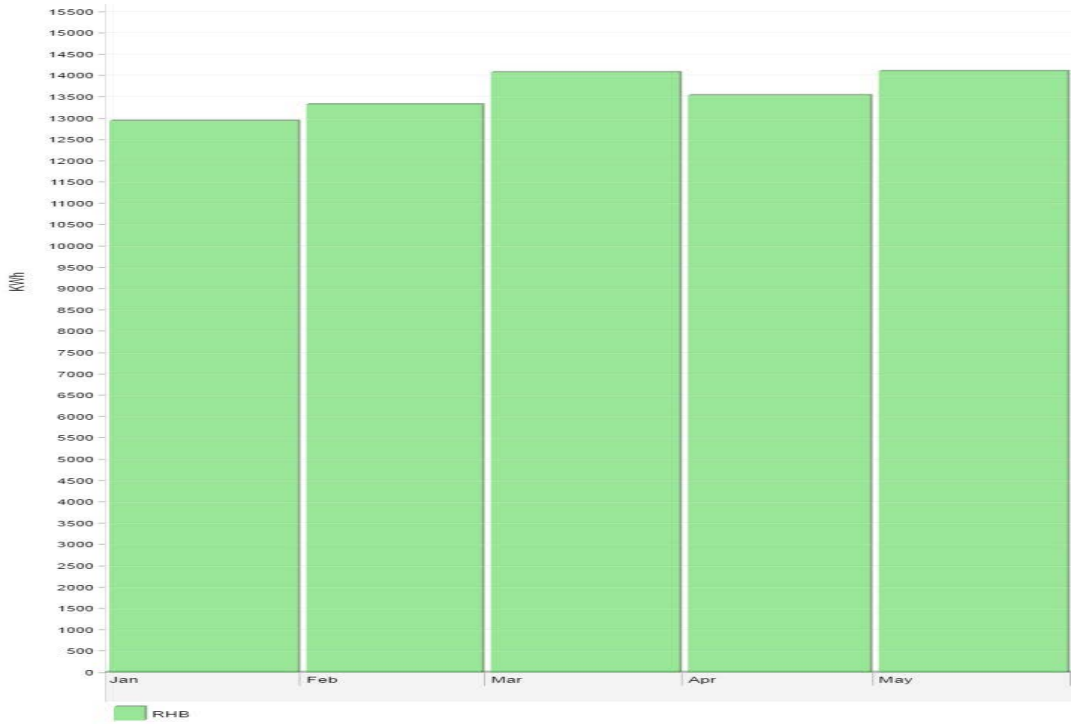


Figure 6.12 Example of Fluctuating Energy use in the Richard Hoggart Building from January to April 2016.

6.4.1 Inconsistency in Reporting Energy Consumption.

This research fails to offer a clear “like for like” comparison of energy use at Goldsmiths in all classrooms across campus on a twenty-four-hour basis. As not all teaching rooms had individual energy meters installed, it is not possible to conclusively correlate whether stakeholders switching off lights was directly responsible for any reduction in energy use in any building. Offices on Dixon Road and Laurie Grove for example have individual energy meters, whereas larger buildings have plant equipment that supplies energy to multiple buildings. BMS meter readings in these buildings only give data for energy use per month, as oppose to every thirty minutes. For this reason it not possible to pinpoint where and when energy was reduced, making it unclear if it was SEOs who switched lights and ICT equipment off. Also, some offices and classrooms are undergoing refurbishments, resulting in changes to the size and uses of spaces, making like-for-like comparisons of energy use more difficult. However, lights and ICT equipment were switched off in offices and classrooms with energy meters, yet there was no record of SEOs recording the same energy being wasted followed by a switch-off. This indicated that stakeholders were starting to switch off lights and ICT equipment outside of using the ED web app, so sustainable behaviour was improving and

stakeholders were engaging with the simple concept of switching off lights and ICT equipment when not in use. This further indicated that the barriers of poor stakeholder engagement was overcome.

However, where the energy detective web app did not overcome the barriers to the extent hoped, i.e. the barriers were not significantly overcome, the fifth and final stage of the action research cycle was reached. The researcher adjusted the theory and began to re-examine how the ED web app might be improved.

6.4.2 Gaps in Energy Detective Savings Data.

There were factors affecting energy savings created that were outside the control of this research. The two main factors affecting energy savings included evening cleaning services and evening and weekend courses taking place across campus. The cleaning time for each building was estimated to be two hours and lights would have been left on during this time. Also the total number of hours that short courses were being run was subtracted from the calculation of energy savings. This resulted in real savings to being less than originally calculated, but only under the assumption that cleaners switched lights back off again once they had finished cleaning. This was also a factor that was outside of the control of this research. It was at this point that a follow-on or second action research cycle started. The original theory was adjusted to accommodate new findings and a second cycle of action research began.

6.4.3 The Second Action Research Cycle.

The first stage of the second action research cycle involved developing a plan of action. This new plan included asking the Goldsmiths Security Team to assist in the provision of evidence of cleaners leaving lights on in buildings after cleaning had finished. However, the request was refused as they insisted this was not part of their remit. A total of nine members of the security team were asked to use the ED web app to report incidents of lights left on by cleaners but each refused. This was the only data gathered for the third stage (collect data) of the second action research cycle. After analysing this succinct dataset the researcher concluded that further investigation needed to be carried out on other stakeholders, namely staff and students at Goldsmiths, to establish why they were also not engaging with the ED web app. For the second time the researcher adjusted the theory and began

examining how the ED web app could become a better ICT solution that would overcome barriers to implementation of more sustainable ICT initiatives in UK FHEs. In short, a third action research cycle commenced when this problem was identified.

6.4.4 The Third Action Research Cycle.

The follow-on second stage of the third action research cycle, developing a plan of action, involved interviewing Goldsmiths staff and students to examine their level of awareness of the Energy Detectives' web app. Fifteen members of staff at Goldsmiths were interviewed with the majority of respondents responding as: (a) not being aware of the web app or (b) being aware of it but never using it.

A summary of their responses is given below and is the third part of the third action research cycle i.e. to collect data.

Their reasons for not using the web app included:

1. Being too busy to report energy waste / not having enough time to participate.

- "Being too busy to report energy waste and the web app requiring too much time to register and then use; (Financial Administrator)
- "I just don't have time, I'm mainly at my desk all day, so I don't see where energy is wasted across campus." (Estates and Facilities Department Administrator)
- "I have the Energy Detectives information card on the staff notice board but I never use it myself, I just don't have time, I have my own job to get on with." (Timetabling Officer)
- "I'm sure I've used it at least once, but not loads of times. It's my workload, I just don't have time to be doing stuff like this, I'm mainly office based so don't really get out and about, only if the estates team are doing a walk about."(Surveyor)
- "Yes I've seen the postcard around. I presume it is about PC and lights being turned off etc. and the college is being efficient as possible but I'm afraid I have not used it as I just don't have time to investigate it."(Librarian)
- "Yes I've seen it and know what it is about but, no, I've never used it because I'm just too busy to use it." (ICT/IT Officer)

2. Not having a smartphone/ not willing to use personal minutes/ allocation of data to report energy waste because it is not part of my job;

- "No, I don't have a smartphone, so no internet access and don't like to use mobile phones as we are all too easily connected, I like to switch off". (Departmental Administrator)
- "Yes I've seen it but never used it. I don't have a work phone, just a personal phone but I have limited minutes so I mind having to use my minutes for work-related tasks". (Security Officer)
- "I never realised there were instructions on the back of the card, but I don't have a smartphone anyway".(Security Officer)
- "Yes I know about the ED app. No, never used because we are not given a work phone and I'm not using my minutes and batter power to report energy waste". (Departmental Administrator)
- "Yes. I've seen the logo but not sure what it is about. I've never used it because it's not part of my day to day job".(Procurement Officer)

3. Not being aware of or caring about the project / too many other projects going on across campus;

- "No I've never seen it, but I do know that we are involved in energy use reductions (via Green Impact)". (ICT/IT Manager)
- We are being bombarded with too much information pertaining to other projects going on across campus, I can't keep up with all that's going on at the college." (ICT/IT Manager)
- "Yes I've seen I but never really took the time to notice what it is all about. There are always several projects going on across the college at anyone time, but, yes, I definitely see energy being wasted". (Administrator in Alumni Department)
- "Nobody cares about outside, non-departmental related issues or projects. If you ask staff and students to get involved or complain that they aren't involved enough and are not acting responsibly enough, then I'll get complained".(Librarian)

The researcher then analysed the data i.e the results of the stakeholder interviews and formed a conclusion regarding the third action research cycle. She concluded that a greater amount of communication was needed to counteract stakeholders (a) not being aware of the web app or (b) being aware of it but never using it. In addressing these two issues and developing a plan of action to improve stakeholders' engagement a fourth cycle of action research commenced. The plan of action involved ensuring that articles on the Energy Detectives Project were communicated across campus.

6.4.5 Communicating the Energy Detectives Project Across Campus.

Even though the Energy Detectives project was launched at the start of the 2015–2016 academic year, very few reports of energy waste by staff and students were made, despite using various channels of communication for both groups of stakeholders. In fact an article on the Energy Detectives project was sent to the Goldsmiths Communication team, who included it in the "staff newsletter" at the start of the 2015–2016 academic year. It was also published, as a reminder, at the start of the new year in January 2016 and again at Easter 2016. It was also published in the student newspaper, *The Leopard*, making it to the front page (Appendix XIV). Each of the staff news articles offered an explanation of how the Energy Detectives project worked, the institutional and individual benefits of using it and how staff could get involved (Appendix XVI.1 to XVI.1).

6.4.6 The Fourth Action Research Cycle.

After this plan of action had been developed, it was time to collect any new data for the fourth cycle of action research at Goldsmiths. The data showed that no new staff or students had registered to use the Energy Detectives web app since the publication of the articles. The researcher and SEOs were still the only stakeholders reporting energy waste. Analysis of this data concluded that this was an example of poor stakeholder engagement in itself. It was clear that relying on staff and students to voluntarily use the web app to report energy wastage was not working, despite numerous streams of communications explaining that its use resulted in being entered into a draw to win a £20 gift voucher. Adjusting the theory for a fourth time in an attempt to engage with stakeholders occurred in October of 2016. The fourth cycle of action research commenced with the team of MA students from the

Institute of Creative and Cultural Entrepreneurship (ICCE) asked if they could make the ED project the focus of an eight–week marketing project using social media as its main marketing platform. This action plan would include the MA students utilising the full selection of features and options of Facebook, Twitter and Instagram to promote and market the Energy Detective project as much as possible. The team also had a "live event", which took place on the main green at Goldsmiths campus. The idea was to engage with stakeholders on a face-to-face basis and invite them to register to use the ED web app. Promotion of the ED project by the IMS students took place from the week commencing October 24th with the face-to-face publicity event occurring on October 27th. Data collected from this fourth cycle of action research showed that the event increased the number of registered ED users by twenty-two, going from forty-one to sixty-three on the launch date of October 27th. Data collected also showed that the number of likes and views on Facebook and Twitter increased dramatically, going from eighty-six likes before the IMS students became involved to 167 in the run-up to the event. This increase of eighty-one likes increased further to an additional twenty-nine likes on October 27th, the day of the event, bringing total engagement of Facebook likes to a final count of 194 likes by the events end. Other engagement metrics included ten retweets on Twitter and thirteen new followers. The ED Instagram account that was created for this fourth cycle of action research showed twenty-six followers by the end of the research cycle (Team Awesome Sauce, 2016).

The researcher with help from the MA students analysed the social media data and concluded that the barrier of poor stakeholder engagement was overcome. However, a final ED report created by the MA students, based on the same data from the ED web app report, showed that none of the newly registered users ever used the web app to report energy waste. When questioned why this was the case, stakeholders indicated a fear of "getting someone into trouble" by using the web app to report energy waste (Team Awesome Sauce, 2016). After reporting this latest set of results the researcher considered progressing the ED project even further, by starting a fifth cycle of action research. However, she decided not to adjust the theory and begin again, thereby starting a fifth cycle of action research as it proved to be outside of the scope of this research.

6.5 Conclusion of the Energy Detectives Web App.

The ED web app proved *not* to be a "silver bullet" that tackled all forms of energy waste in each building across campus that resulted in a significant decrease in

energy waste. Instead it proved to be more of a useful tool for the environmental officer in gathering data relating to where and how energy was being wasted across campus and for engaging with the SEOs too. In doing so, it helped overcome three of the previously identified barriers: poor stakeholder engagement, lacking managers and cuts in funding, albeit to a much lesser extent. The web app helped to reduce energy consumption across campus and was part of a holistic effort by Goldsmiths' Estates and Facilities Department to reduce energy waste. It can be concluded that any reduction in energy use was due to SEOs (Energy Detectives) switching lights off at the time of reporting energy wastage – an initiative prior to engaging with the Energy Detectives project would not have been carried out. Below is a summary of how three barriers were overcome using the ED web app and their supporting evidence.

Table 6.5 Overcoming the three main barriers.

Barrier	How it was Overcome	Benefits of Use to Universities and Colleges.	Evidence
Lacking Managers	Makes reporting ICT energy waste instant.	Managers are now better resourced in gathering this data.	Response from interviews with Environmental Officer and Deputy Director of Estates and Facilities (Energy and Engineering).
Stakeholder Engagement	Makes reporting of ICT energy waste easy.	Stakeholders are enthused to play their part in energy use reduction.	Reports of energy waste came from SEOs and staff.
Cuts in Funding	It's free to use and cost less than £1,000 to create. Helped save money which alleviates cuts to funding.	Minimal capital investment can result in significant savings in reduced energy bills.	Response from interviews with Environmental Officer and Deputy Director of Estates and Facilities (Energy and Engineering)

6.5.1 Shortcomings of the Energy Detective Web App.

However, the Energy Detective project also demonstrated that staff members do not engage in sustainable behaviour to the extent that the Environmental Officer had anticipated. Stakeholders did not switch lights and ICT equipment off as frequently as they should have. The project also demonstrated that staff will engage in reporting energy wastage but only when included in their job remit, i.e. engagement is conditional on a reward. The web app did not overcome four other barriers. Those barriers included government organisations as drivers for implementing sustainable ICT projects, budget-holders and decision-makers not supporting the implementation of sustainable ICT projects and institutional culture or sustainable technology not being considered as sustainable as they are marketed as. While there were elements of stakeholder engagement with the web app, it mainly occurred when its use was included in staff's job description.

Table 6.5 summarises how the Energy Detectives project can overcome each of the seven barriers, even if it did so only on a minimal level at Goldsmiths. There is clear evidence that at least three of the barriers (poor/disjointed stakeholder engagement, lacking managers and cuts in funding) were overcome.

6.5.2 Improvements in Stakeholder Engagement, Lacking Managers and Cuts in Funding.

However, despite low levels of engagement with stakeholders, follow-on interviews with Goldsmiths staff and students indicate that general awareness of environmental issues and on energy waste and green ICT initiatives in particular on campus is improving. Comments from staff and students included being more aware of sustainable initiatives going on across campus and being invited to participate. Stakeholders also commented that since the Greening Goldsmiths Facebook pages and webpages had been created, finding information regarding sustainable improvements to Goldsmiths was easier.

> *"Yes, I'm more aware of other green/sustainable ICT events on campus as the greening officer informs us when they are happening." (Administrative Assistant)*

“There is a poster at the main security desk explaining energy wastage and I’m aware of greening initiatives.” (Security Officer)

I was impressed when I first saw the solar panels on the roof of the RHB, very nice to see the college saving money.” (Student)

Where managers were lacking in resources before, other sustainable initiatives that required stakeholder engagement showed a marked improvement. Stakeholders were aware of the importance of playing their part in aiding lacking managers to save Goldsmiths money. The underpinning contribution each of these three barriers have with one another also means that when improvements, are made in one, improvements to the other two automatically follow suit.

“The greening officer is always turning lights and ICT equipment off when not being used so now I switch lights off as well, even at home” I’ve even started to be more mindful where other university resources are concerned like the amount of paper I use.” (Financial Officer)

“Yes, definitely an improvement in the awareness of greening issues, especially energy along with help from Green Impact but I’m green minded anyway.” (Procurement Manager)

“Yes a definite improvement to try to reduce where possible, but I’m not going to be cold or too hot but try to be sustainable i.e. windows open etc. I was aware anyway as I’m green at home, but this has helped by making me better informed.” (Departmental Receptionist)

There is another example of how through stakeholder engagement the Careers Department managed to reduce their overall energy use in 2015–2016 despite their number of staff doubling (Appendix XIII). This department was a participant in Green Impact so would have been very aware of the Energy Detectives project and the college’s need to reduce energy waste. In doing so they aided lacking managers, namely the SES, officer and offset any cuts in funding by reducing energy waste.

6.6 Summary of Chapter 6

The ED project answered the research sub-question relating to ICT solutions alleviating the effects of barriers and limiting factors. It also demonstrated the benefits of the use of such technology for universities and colleges. It also highlighted how difficult energy management in large organisations with transient populations and a continually changing campus can be. It highlighted the disinterest of staff and students in participating in energy management projects especially if it is outside of their remit and the value of receiving such feedback even in its negative form (Pollard, 2016). At this stage, the research was technically complete in that an ICT solution to UK and Irish FHE institutions overcoming the barriers to implementing sustainable ICT initiatives had been found. The research question and its sub-questions were also answered and its aims and objectives achieved. However, on a broader scale this research also identified a series of sector-related issues that underpinned each of the barriers and which contributed to ongoing unstainable behaviour within the sector. A conclusion to those sector-related issues, as well an overall conclusion to the survey's results and recommendations for future research is included in the next Chapter, Chapter 7.

Chapter 7. Discussions, Conclusions and Key Implications of the Research Findings.

7.0 Introduction.

This chapter offers a series of conclusions to the various outcomes of the results of this research. It offers an overall conclusion to the research question, sub-questions and how they were answered. The most significant aspect to this chapter is the conclusion that each of the seven barriers do in fact exist and that many of them underpin at least one other barrier. The key implications of each of the barriers are included, as well as how useful the ICT solution - the Energy Detectives web app - was in overcoming the barriers. This chapter is essentially bringing together the key findings and outcomes of Chapter 4's sustainable ICT case studies, the results of the main UK and Irish surveys from Chapter 5 and the key outcomes of Chapter 6 – the Energy Detectives project. It also shows how their findings relate back to the context of this research and if the research question and sub-questions have been answered. In short, this chapter is effectively "zooming out" (Kapogiannis and Sherrat, 2016).

7.1 Discussion and Conclusion to Answering the Research Question.

This research commenced with a desire to bridge a gap in knowledge that existed within the FHE sector. That gap pertained to the difficulty in implementing sustainable ICT initiatives in FHEs and so the research question asked:

1. What are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives?

Its follow-on research sub-question asked:

2. What are the key implications of those barriers?

Sections 7.1.1 to 7.1.5 of this chapter discuss and concludes on how the research question and its first sub-question was answered.

7.1.1 Discussion, Conclusion and Key Implications to the Preliminary Surveys.

(i) Procurement for Green ICT by ICT/IT Managers.

In Chapter 4, responses in the Procurement for Green ICT by ICT/IT Managers Survey showed a disparity of knowledge and understanding of greener ICT. The majority of responses indicated that ICT/IT managers were aware of the environmental impacts the use of ICT has on the environment and less than 10% did not. This survey also showed a willingness by those ICT/IT managers to improve their environmental knowledge and become a more engaged stakeholder where greener ICT initiatives are concerned. Procurement managers also indicated a willingness to sit on their institution's environmental committee, if asked (Hogan, 2011a). It can be concluded that ICT/IT managers are often unaware of the benefits of greener ICT and therefore this is considered a barrier. For the full analysis of this survey, see Appendix XI.1

(ii) Procurement Managers Knowledge of Green ICT Survey.

Key findings from the Procurement Managers Knowledge of Green ICT Survey indicated a very good background knowledge of sustainable issues where it may not necessarily be an essential requirement for their role. This survey also indicated a strong presence of procurement managers on environmental committees in some institutions and an understanding of the most important factors such as energy use and the life length of a product when procuring for ICT equipment. These findings show that the barrier that is budget-holder and decision-makers' not procuring for greener technologies may not have existed at their institution. Similarly to the Procurement for Green ICT by ICT/IT Managers survey, responses indicated a willingness to learn more about greener ICT; this also indicated the opposite of poor stakeholder engagement. For a full analysis of this survey, see Appendix XI.2

(iii) Cuts in Funding.

5.6% of respondents to the Cuts in Funding survey indicated the barrier that is that cuts in funding did *not* exist at their institution. 71% of institutions who had their funding cut implemented sustainable initiatives such as switching off ICT equipment

and lights when not in use, investing in energy-saving equipment and engaging in behavioural change (Patrick, Murray and Bowles, 2008).

However, the implications of this barriers was different at each institution. While across the sector cuts in funding may have adversely affected institutions' ability to implement greener ICT initiatives, others regarded those measures of austerity as opportunities to examine their wasteful practices and identify where improvements could be made (Fowlie, 2015; Ngim, 2013). For others, it strengthened their resolve for more extensive use of sustainable equipment across campus (Hewitt, 2009) (see Figure 4.14). In fact UK FHE institutions have also indicated a more conscientious and innovative approach to their environmental decision-making since the cuts were announced. For a full analysis of the Cuts in Funding survey, see Appendix XI.4.

To summarise, four preliminary surveys, in total, were carried out whose collective results indicated a series of barriers to FHE institutions implementing sustainable ICT initiatives, albeit to varying degrees. Those barriers included cuts in funding, restrictions from budget-holders and decision-makers when procuring for greener technologies and managers lacking in a series of resources crucial to the efficient and sustainable running of an institutions' ICT infrastructure (Allman, Fleming and Wallace, 2004.) The implications of the survey findings is that it prevents institutions from operating as sustainably as possible resulting in continued waste of resources.

7.1.2 Discussion, Conclusion and Key Implications of Results of the UK and Irish Survey.

Results of the UK and Irish survey clearly identified seven barriers to participation in sustainable ICT projects and also established the level of their existence. The key implications of each of those barriers have also been established from the responses to the lines of questioning within both surveys. It can also be concluded that each barrier existed in every institution to varying degrees; in some instances they existed extensively, in others only at a minor level. Even the preliminary surveys underpin this. It can also be concluded that the list of categories of FHE managers included in this research, have a broad range of responsibility within each of their remits. 43% of them did not consider their job to fall into any single category of the seven job categories listed, but on closer examination, the job was in fact ICT/IT or environmental- or sustainability-related, thereby showing that one category of job title did not suffice for their roles. Neither carbon management nor space

management were chosen as a job description and this is because both are often also the responsibility of environmental and sustainable managers at an institution. This again suggests that FHE managers' remits are often very broad (Prospects.ac.uk, 2017). It can also be concluded that managers in FHE institutions typically have years of experience, with some managers working in the sector for their entire working careers. This adds credibility to the responses as both early-, mid-, and end-of-career managers all participated in the survey, offering a balanced input from managers from the full spectrum of experiences (Coughlan, 2017).

Similarly, the key implications of the results of the UK and Irish surveys are that the barriers prevent FHE institutions from operating as environmentally sustainable as possible. An additional implication is that stakeholders, being unable to address and overcome them, continue in their sub-optimal environmental performance.

(i) Poor Stakeholder Engagement.

The level of stakeholder engagement in ICT initiatives at UK institutions varied depending on the level of interruption required by the use of that piece of kit. If a newer, more efficient, more sustainable piece of technology worked with minimal disruption to established services, then stakeholders became engaged and less interested in its green credentials. This research showed that ICT/IT departments tend to work in silo and are reluctant to make any changes unless they are essential (Beal, 2017). In addition, sustainability is not high on their list of priorities. However, should problems or interruptions arise, simply informing stakeholders why changes are being carried out – attempting to reduce running costs and reduce carbon emissions –, can result in improved engagement and even participation. Therefore, communication is key to overcoming this barrier. Training and education on the subject of green ICT, and in the wider subject of sustainability, would put ICT/IT staff at ease and therefore help overcome this barrier (McManus, 2009; GEANT, 2017). The implications of this barrier therefore is that green ICT is not utilised where it could be, and not as much as it could be, so the opportunity for cost and carbon savings are lost.

(ii) Lacking Managers.

It can also be concluded that lacking managers are a barrier, as responses in both the UK and Irish surveys indicated this. The main barrier identified within the answer

options of lacking managers was being under-resourced in three ways: staff training; funding; and support staff. Coincidentally, each of these barriers is underpinned by cuts in funding and budget-holders and decision-makers as also evidenced in the SUSTE-TECH and Scotland projects. Therefore it can also be concluded that each of the barriers underpin and even exacerbate one another, causing an even greater barrier (Hogan, Jimenez-Bescos and Frame, 2014). It follows then that the key implications of this barrier and how its underpinned by other barriers is that managers are not benefiting from the use of greener ICT so savings are lost and their inability to manage more efficiently continues.

(iii) Cuts in Funding.

Cuts in funding to the educational sector since 2010 have affected institutions' ability to participate in sustainable ICT projects and are therefore a barrier. This is evidenced not only from the responses in both the UK and Irish surveys but also from a 2012 survey carried out on the subject (Hogan, 2012). The implications of having streams of funding cut are given in section 7.1.1 (iii). However, despite being evidenced as a barrier in this research and in the preliminary research, cuts in funding was also shown *not* to be a barrier but only according to environmental managers. There is also evidence to suggest that many institutions have *not* in fact had their funding cut, but having instead obtained it elsewhere, have chosen to spend it on other estates-related initiatives. Institutions are focussing on refurbishing existing buildings, demolishing older ones and erecting new buildings, all in an effort to increase capacity (AUDE, 2014). They are investing in state-of-the-art ICT facilities and offering many features and services that will enhance the student experience (AUDE, 2017), as it is student fees that are providing up to 80% of their total income, whereas before it came from the government. While the researcher could not find any record of a senior member of an FHE such as a president or vice-chancellor stating that sustainability is not as important as it once was, it had been reported that only activities that are central to an institution's core business will received funding. In fact, research conducted in 2016 examining carbon management policies in the HE sector concluded that this was precisely the case (Mazhar, 2016).

(iv) Institutional Culture.

Unsurprisingly, as the overall survey results regarding the question of institutional culture being supportive of the use of green ICT were mixed. Some institutions stated that green ICT was part of their culture and others indicated it was not. The implications of an FHE institution not having a culture that supports the use of greener technologies for both teaching and research as well as administrative and operational purposes is that they may fail to compete with other more technologically cultured institutions. As ICT is becoming increasingly engrained in society, not being a part of it is a distinct disadvantage to an institution.

(v) Government Organisations as Drivers.

It can be concluded that there appears to be no singular government organisation that was overwhelmingly chosen as being either a very poor or a very good driver, although the funding organisation Salix, received a good review overall. The implications of this barriers is that with no government incentive to include green ICT as part of an overall carbon management plan, FHE institution managers are marginalising it in favour of more obvious energy consumers such as newer and more efficient plant equipment and the insulation and replacement of pipework.

(vi) Budget-Holders and Decision-Makers/ Being part of a Purchasing Framework.

Procurement managers were asked about procuring for greener technologies and this research's surveys concluded that those with purchasing power i.e. budget-holders and decision-makers, do not always consider longer-term cost and carbon savings as they do not have the budget for greener technology, therefore further evidencing it as a barrier (Bannister, 2004, p29). It can be concluded that while purchasing frameworks are in place in some institutions with procurement managers supporting staff in their purchase of greener ICT, this is not the case in all institutions. While it is not a significant barrier, it still exists. The key implication of this barriers is that greener technologies are far less likely be used in those institutions and like all barriers it will results in lost opportunity for cost and carbon savings. If staff having little knowledge of the benefits of utilising purchasing frameworks to make more sustainable and cost-effective purchasing decisions was supported by a survey conducted in 2011 (Hogan, 2011a). Therefore, institutions need to consider making education for sustainable development part of their cross-departmental staff

training. This will, in turn, overcome the barrier of budget-holders and decision-makers not being aware of the environmental and financial impact their decisions have (CIPS, 2009, pp 3-4).

(vii) Performance of Sustainable Technology

It can also be concluded that FHE managers do not believe in the financial and carbon savings promised by sustainable technology companies (Jones, 2013; Pearce, 2008). Comments made in the survey suggest that any financial savings made were lost in the initial purchase costs and that any real reductions in overall environmental or carbon footprint were eliminated in purchasing new or additional technology (Kumara, 2013). Despite survey results indicating a minimal cost and carbon saving, greener technologies are still widely used in institutions and are in fact, contributing to considerably smaller carbon footprints (JISC, 2014a). This, in turn, is because new technologies are greener by default as they are designed to be smaller, more lightweight and less energy-intensive and therefore cost less to run (Velte, Velte and Elsenpeter, 2008). Multifunctional devices, video conferencing and automatic powerdown of devices, proved to be the most widely implemented of technologies and this is because they typically free up space and save staff time and running costs as well as carbon emissions (JISC, 2015b).

7.1.3 Discussion, Conclusion and Key Implication of Comparison of UK Versus Ireland Survey Responses.

It can be concluded from the comparison between responses in the UK and Irish surveys that FHE institutions in both countries experienced each of the same barriers when implementing sustainable ICT initiatives, albeit to different extents. Responses indicated a similarity between the two countries when attempting to be greener, particularly where their purchase of ICT was concerned. Yet in other instances they had opposite views and this is likely to be because the majority of respondents in the Irish survey were ICT/IT managers and none were environmental/sustainable managers. The significance of these findings is that barriers to implementation of sustainable ICT initiatives exist in institutions regardless of geographical location (Allman, Fleming and Wallace, 2004; Wabwoba, Wanyembi and Omuterema, 2012; Wu, 2002).

7.1.4 Discussion, Conclusion and Key Implication of Comparison of London Versus Rest of the UK Survey Responses.

It can be concluded that the majority of the respondents in the UK survey were from the London region. This is likely to be because the researcher was part of the LUEG and had networked with several FHE managers from London institutions over the course of the research. However, despite the disparity or similarities in the numbers of responses they still represented six categories of FHE managers across the UK including the category of “Other” manager. The majority of managers from both regions had been in their roles ten years or less as well as having worked in the sector for approximately the same period of time. This indicated a young but not inexperienced work force which offered valuable input into where and how improvements to the sector could be made (Coughlan, 2017).

It can also be concluded that there is both engagement and disengagement by stakeholders in both London and the Rest of the UK institutions when implementing sustainable ICT initiatives. Institutions from both UK regions implemented a green ICT initiative of sorts and is therefore a good indication of the uptake of green ICT across the UK FHE sector as a whole. Their engagement is as a result of being informed of any changes being made and those changes being implemented gradually. Any disengagement from either region was as a result of a resistance to behavioural change and a lack of confidence in green ICT initiatives (d’Arjuzon, 2012).

Survey results also indicated that green ICT is more part of the culture of institutions from *both* parts of the UK, than not. This is due to the younger workforce who completed the survey and who appear to be more knowledgeable about technology and its impact on the environment and therefore made a unique contribution contributed to this research (Garthwaite, 2017; Folkman, 2015).

It can also be concluded that overall government organisations were *not* considered to be very strong drivers by institutions in either London or the Rest of the UK (Randerson, 2010; Plumer, 2013). This will have contributed to such poor levels of participation in green ICT projects. While some institutions regarded HEFCE and DEFRA as being excellent drivers, they were also considered to be poor drivers by others from both regions. Overall there is no significant disparity in responses regarding government organisations as drivers between London institutions and those in the Rest of the UK.

Institutions in the Rest of the UK indicated that green technology delivered on the financial and carbon savings promised by IT companies, more so than London institutions. London institutions' sole reason for not believing in the benefits of green ICT was that purchase costs exceeded any saving recouped in reduced energy costs. The disparity between London and the Rest of the UK responses is therefore due to the overall higher cost of living London (Numbeo, 2017; Rej, 2016). Cuts in funding to the sector impacted institutions from both regions to some degree but their affects were alleviated by reassigning funding to support sustainable projects.

There is a lack of education and training in institutions in both London and the Rest of the UK regarding membership of purchasing frameworks and any support such frameworks offer. A key implication of this is that it is likely to impact the purchase of greener technologies in both London and the Rest of the UK institutions. It can be concluded that managers in both London and the Rest of the UK institutions are lacking in each of the characteristic listed. Barriers that affect London institutions in participating in sustainable ICT projects, also affect institutions across the Rest of the UK and in similar amounts too. This further demonstrates the similarity in management set-up and operations of all FHEs and that barriers exist in every organisation (Barry, 2007: 2013).

7.1.5 Discussion, Conclusion and Key Implication of Comparison of ICT/IT Managers Versus Environmental/Sustainable Managers Versus Other Managers' Responses.

It can be concluded that the mixture of responses from the various categories of managers is due to each of the categories of managers having different dynamics to their relationship with stakeholders and are therefore likely to offer different responses to this question. It can also be concluded that the reason for the similarity of results from each of the three categories of managers, with a slight indication that green ICT being is part of their institutional culture, is because each of their job roles overlaps with the promotion of greener ICT and its institutional benefits.

All three categories of managers gave a mixture of responses regarding each of the government organisations as drivers for greener technologies and this is because they each had a different experience with at least one of the government organisations. It can be concluded that there is a mixture of opinions regarding green technology delivering on the financial and carbon savings promised by ICT/IT companies from each of the three categories of managers. Similarly, this is because each category of managers has a difference experience in the use of green ICT and

in its delivery of cost and carbon savings (Hogan, 2011a). Cuts in funding affected each of the managers differently with Environmental/Sustainability managers indicating not being affected at all. Similar responses were given the in 2012 Cuts in Funding survey (Hogan, 2012), where FHE managers indicated having less funding as an opportunity for reducing consumerism and thereby reducing their overall environmental footprint. It can also be concluded that there is cross-departmental awareness of purchasing frameworks in UK institutions, but levels of awareness amongst managers is mixed and this sometimes leads to less sustainable decisions being made (Hogan, 2011a; CIPS, 2009 pp3–4). It can also be concluded that within each job role in any university the same barriers are experienced albeit it to varying degrees and that typically, more than one barrier is experienced.

A key implication of being under-resourced as regards support staff, allowances for staff training and having a disinterest in outside green ICT projects is that, combined, are the most undermining and debilitating characteristics of a lacking manager (Enochs, 2012; Guardian Work Blog, 2013). However, in contrast some institutions have ICT/IT managers who claimed to not be lacking in any way. This is due to their working in silo and having minimal engagement or interaction with stakeholders and therefore were unaware of any issues, environmental or otherwise, that was outside of their remit (Beal, 2017).
It might also be that due to their level of personal commitment, motivation, education or remuneration that they were unware of how their institution may be lacking.

Finally, it might also be that some institutions are very well resourced and managers are not lacking in any regard.

7.1.6 Final Discussion, Conclusion and Key Implication to Sustainable Information and Communication Technology (ICT) Initiatives in UK and Irish Universities and Colleges: Identifying and Overcoming the Barriers to Implementation.

Chapter 4 showed that barriers to implementing greener ICT initiatives exit in institutions in Scotland and in the UK to varying degrees, with poor stakeholder engagement and lacking managers being the more commonly found barriers. Cuts in funding was also shown to be a sustainable barrier, but to a lesser extent and while the remaining four barriers also existed, they did so also to a much lesser extent. Chapter 4 also showed how sustainable ICT projects can easily “fail” despite

the best intentions of environmental and ICT managers. This “failure” typically occurs if a culture of sustainability does not exist or if budget-holders and decisions-makers do not have the financial foresight to see the value and long-term savings that can be made in procuring for greener, more energy-efficient technologies (Wabwoba, Wanyembi and Omuterema, 2012). The four surveys in Chapter 4 of this thesis also showed the differences in experience of the barriers in the various types of managers working in the UK FHE sector. Whether a survey participant was an ICT/IT manager being questioned on their knowledge of green ICT or a procurement manager being questioned on their understanding of the benefits of using more energy-saving ICT equipment, the outcomes are the same; barriers to implementing greener ICT initiatives exist in FHEs across the UK and the globe to varying degrees (Hogan 2011a: 2012; Sheehan and Smith, 2010).

The outcomes of the SUSTE-TECH independent report also concluded that there were barriers to the success of that particular project too (Shreeve and Curtis, 2012). After further investigation and closer examination of each of the barriers on a larger scale, the extent to which they existed and ultimately affected institutions’ ability to implement sustainable ICT initiatives were shown in Chapter 5. The research sub-question – what are the key implications of those barriers – was also answered via the responses to follow-on questions pertaining to each of the barriers and via the comments left in the comments sections.

Where the responses in Chapter 5 Part (I) and Part (II) show that barriers not only existed but underpinned one another, the key implication of that is the barriers are then exacerbated. It can be concluded that Chapter 5 eliminated any doubt that barriers to implementing greener ICT initiatives existed, to what extent they existed and what the key implications of those barriers were.

Unsurprisingly, responses to questions in Chapter 5’s UK and Irish survey were similar to those in the responses of the four surveys featured in Chapter 4. Stakeholder engagement, lacking managers and cuts in funding were prevalent in each of the institutions whose managers took part in each of the four surveys (Isaksson et al., 2011). Sentiments expressed by managers who participated in either only one or each of the four surveys in Chapter 4 indicated that they had experienced at least one and in some cases all seven of the barriers at their institutions, either directly or indirectly.

For example, institutions *not* having a culture of environmental sustainability, ICT/IT managers *not* being asked to be part of their environmental committee and/or *not*

being offered training in greener technologies etc. all contribute to the barrier that is poor stakeholder engagement.

Procurement managers / budget-holders and decision-makers, also, indicated in their bespoke survey that government organisations as drivers, and sustainable technology *not* being as green as anticipated, were clear barriers. In addition, procurement managers stated that they had *not* been asked to join their institution's environmental committee, did *not* have time to join or no such committee existed at their institution. These are examples of the barriers that are poor stakeholder engagement and lacking managers (Ojo, Mbowa, and Akinlabi, 2014; Murugesan 2013). However, another key finding arising from the comparison of the results of the four surveys in Chapter 4 and the responses in the main UK and Irish survey in Chapter 5 was that for some institutions the barriers did not exist at all. Where they did, there was a willingness from staff to participate in overcoming those barriers. This willingness is similar to that found at institutions that are exemplars of living laboratories where staff and students actively engage in the sustainable operation of their campus (University of Cambridge, 2017). It is also an example of continued interest in seeing sustainable agreements, treaties, declarations and policies embedded into practice (sustainabilityexchange.ac.uk, 2016a). This willingness to be greener coupled with the desire to set a better example is part of a new and emerging set of social values where stakeholders are collectively aiming to reach a common goal (Parr, 2009, p.3). While that category of manager experienced each of the other six barriers, they indicated that cuts in funding only further supported their aims of a greater reduction in consumption consumables and a greater focus on reducing and reusing (Patrick, Murray and Bowles, 2008). It might also be that senior managers choose not to issue cuts to the sustainable/environmental team, as it is seen as a cost saving department, whose operations should not be undermined in anyway (Makower, 2006; Lyons-Hardcastle, 2013).

7.1.7 Final Discussion, Conclusions and Key Implication to the ICT Solution: The Energy Detectives Web App.

The second research sub-question – how can a sustainable ICT solution alleviate these barriers – was explored using action research which revealed that an ICT solution can overcome some of the barriers albeit at a minimal level. This sub-question was answered via the creation of the Energy Detective web app which was discussed in detail in Chapter 6: The Energy Detectives Project. This chapter demonstrated that at least three of the barriers could be overcome, using an

inexpensive web app. However, even in trying to create an ICT solution that would overcome some of the barriers, the researcher experienced one particular barrier she was attempting to overcome, namely poor stakeholder engagement. On investigation into why poor stakeholder engagement still existed despite the use of the energy detective web app, interviewees offered a number of reasons. Those reasons included not feeling that tackling energy waste was within their remit, not having time to report energy waste (lacking managers), not owning a smartphone (lacking managers), not being assigned a work phone and therefore not willing to use personal minutes on work related matters. However, even this negative feedback proved useful as the SES Officer at Goldsmiths (the researcher) can use it, when and if, she decided to conduct another cycle of action research. This feedback also proved useful for obtaining an overall consensus of how staff and students at Goldsmiths feel about reducing energy waste and Goldsmiths can do to meet their needs so as to improve stakeholder engagement (Pollard, 2016). Each of the contributing factors of poor stakeholder engagement mentioned may also be underpinned by cuts in funding.
If more funding was assigned to staff to counteract each of the responses to not engaging with the web app, greater participation in the Energy Detectives' project and therefore greater reduction in energy waste would occur.

It can also be concluded that despite the use of technology and social media being one of the more engaging and successful ways forward in tackling energy waste in large organisations (Hilty et al., 2006; Crowley, Curry, and Breslin, 2014) using it to overcome the barriers identified in this research was *not* as successful as expected. In fact, four cycles of action research were required before stakeholder engagement with the web app reached saturation point. It was at this stage that the researcher decided that starting a fifth cycle of action research would not lead to further stakeholder engagement or overcome the barriers anymore.

It was also discovered that in attempting to design an ICT solution that would overcome the barriers by engaging with stakeholders and proving to be a valuable tool for lacking managers, the same set of barriers was experienced by the researcher. While attempting to implement a green ICT initiative that would help reduce energy, the same barriers were experienced, i.e, poor stakeholder engagement and lacking managers (Suryawanshi and Narkhede, 2015).

Chapter 6 answered the second research sub-question and demonstrated the benefits of the use of such technology for universities and colleges (JISC, 2015c). It also highlighted how difficult energy management in large organisations with transient populations and a continually changing landscape can be (Carbon Trust, 2012). Finally, it also highlighted the disinterest of staff and students in participating in energy management projects especially if it is outside of their remit (Green, 2015).

7.2 Broader Conclusion and Research Implications.

The barriers identified this this research and any recommendations given to overcoming them is not exclusive to FHEs, they also apply to organisations of all sizes. Nor are the barriers exclusive to what occurs when implementing greener ICT initiatives, they are also likely to occur when implementing sustainable initiatives of any kind for e.g. as trying to improve rates of recycling. SME's, schools hospitals and larger multinational organisation are likely to also experience the same barriers, have each barrier underpinned by another barrier and struggle to find an ICT solution that will help overcome those barriers.

The most significant implication of this research to businesses is they can create their own bespoke ICT solution following this research's methodology.

Forearmed with the outcomes of this research, if businesses put contingency measures in place at the start of implementing greener ICT initiatives they are likely to save significant amounts of money, through avoiding any unnecessary costs associated with poor stakeholder engagement, poor performance of greener technologies unnecessary ICT purchase costs, energy waste and having a culture of being environmentally unsustainable. In addition managers are also likely to benefit from being better resourced through having a bespoke mobile web app that helps with typical managerial issues, such as being time-poor, having a limited budget to run projects with and trying to find a clever way of engaging with staff to play their part in making the campus greener.

7.3 Achieving the Research's Overall Aims and Objectives.

The overall aims and objectives of this research were met when a total of seven barriers were identified and the key implications of each one evaluated and an ICT solution was created that helped overcome at least three of the seven barriers. It can also be concluded that almost all of the barriers exist in FHEs across the UK

and Ireland regardless of geographical location and are experienced by a variety of FHE managers within each of their respective roles at each of their respective institutions. The only exception to these results is the presence of the barrier, cuts in funding, as identified by environmental and sustainability managers (see Table 7.1) (Hogan, Jimenez-Bescos and Frame, 2015).

Table 7.1 Summary of Barriers by Geographical Location and Category of FHE Manager.

Groups Analysed → Barrier Identified ↓	UK Insts.	Irish Insts.	London Insts.	Rest of UK Insts.	ICT /IT Mgrs.	Env/ Sust. Mgrs.	Other Mgrs.
Poor Stakeholder Engagement.	✓	✓	✓	✓	✓	✓	✓
Inst. Culture.	✓	✓	✓	✓	✓	✓	✓
Govt. Orgs as Drivers.	✓	✓	✓	✓	✓	✓	✓
Green Tech. delivering on Financial and CO_2 savings promised by IT comps.	✓	✓	✓	✓	✓	✓	✓
Cuts in Funding.	✓	✓	✓	✓	✓	×	✓
Actions of Budget-Holders and Decision-Makers/ Institutions being part of a Purchasing. Framework.	✓	✓	✓	✓	✓	✓	✓
Lacking Managers.	✓	✓	✓	✓	✓	✓	✓

7.4 Overall Discussion and Conclusion of the Research Findings.

For all or some of the reasons given, poor or disjointed stakeholder engagement, in its many forms, can be considered a barrier to participation in sustainable ICT projects and are often interconnected and rarely in isolation (Schawbel, 2013; Egeland, 2009; Suryawanshi and Narkhede, 2015). While some barriers are clearly connected, others appear to be separate. Even separate barriers are likely to show degrees of interactions with other barriers on further research. It is also likely that just one barrier underpins all the others (Hogan, 2012). For example, when sufficient funding is in place, institutions are afforded the time and resources to complete projects. This includes the provision of staff training and assistance, the purchase of necessary equipment and the engagement with organisations that charge for the service of their advices. Sufficient and continuous funding to the FHE sector is essential to its development and expansion. Without it, institutions cannot remain competitive, the quality of teaching and research suffers and sustainable projects are scrapped or pressured to finish earlier (UUK, 2016a; HEFCE, 2015;THE 2012, Hogan, 2009). As stakeholder engagement in FHEs now includes students and staff, local councils, SMEs and local residents, each contributing to an institution's survival (O' Boyle, 2012), *their* poor level of engagement and failure to overcome barriers resulting in sustainable under-performance, is also considered a barrier (Allman, Fleming, Wallace, 2004).

Disjointed stakeholder engagement may have occurred as a result of a breakdown in communication between managers in the same institution or between local councils. It may be that communications between those involved in either the Scotland project or the SUSTE-TECH project stopped occasionally but not entirely. This may be for a number of reasons such as a change in management, job remits expanding and departments downsizing or consolidating. This research has demonstrated the importance of continued stakeholder engagement from all parties concerned for the full duration of a project and should be considered an essential prerequisite for university initiatives, sustainable or otherwise.

7.5 Recommendations on how FHE Managers Avoid the Barriers and Implement Sustainable ICT Initiatives.

Based on the conclusions to each of the barriers given, the following recommendations can be made to FHE managers on how best to avoid or overcome the barriers when implementing sustainable ICT initiatives.

7.5.1 Poor Stakeholder Engagement.

In advance of implementing any type of sustainable ICT initiative, particularly if it involves a cross-section of staff with differing remits, ensure that all stakeholders are fully aware of what the initiative is and their role in ensuring its success. Ask staff to sign a memorandum of understanding to the effect if necessary particularly where larger more expensive initiatives are concerned. Signing the memorandum will further clarify to the stakeholder what's required of them thereby avoiding any confusion regarding their role and how essential their commitment is. Give the stakeholder the opportunity to voice any concerns they may have regarding their ability to commit to the initiative. Concerns may include; too great a workload already, feeling that the initiative is outside of their remit, not believing in "green" ICT etc. The stakeholder leading the implementation of the initiative (typically the ICT/IT manager or environmental/sustainable manager) should address those concerns and offer support.

7.5.2 Lacking Managers.

Ask managers what resources they need or expect to need prior to and during the implementing of the greener ICT initiative. Where assistant staff is requested invite more junior members of staff and interns to assist.
Explain that any staff adding the championing of sustainability to their list of responsibilities is likelier to be promoted when the opportunity arises. Where funding is available explain how they will be financially rewarded for their efforts. Where a less than enthusiastic approach is the barrier, add environmental sustainability to the remint of new roles and where funding is available explain how this added responsibility is reflected in their salary.

7.5.3 Cuts in Funding.

Where funding for sustainable ICT initiatives has been cut, implement the “cost-free” initiatives such as automatic power down, print and copy double-sided, etc. Demonstrate to budget holders and decision makes the savings that can be made through the use of more sustainable ICT equipment and using the SusteIT Tool identify which areas of the current ICT system’s needs immediate attention.

Capture the “hearts and minds” of staff and explain how the collective simple action of powering down/off ICT equipment can reduce energy waste and therefore carbon emissions. Explain how that collective community needs to play their part in tackling climate change. Start an energy reduction competition between offices that have individual energy monitors and offer prizes to offices or departments who have the greatest percentage of reduction per staff member. Instil a sense of duty amongst staff to reduce ICT energy use and explain the importance of the individual’s role in tackling climate change. Referencing the Carbon Management Policy or similar be included in ongoing staff training and when new staff are inducted.

7.5.4 Institutional Culture.

Changes to culture are possible once savings in ICT running costs are demonstrated. As FHE institution are currently being operated with increased profitability in mind, explain how greener ICT drives profitability in two ways; reduced ICT running costs and is the preferred option for fee-paying, environmentally conscientious students.

7.5.5 Government Organisations as Drivers

Where government organisations have been poor/weak drivers, explain to senior management that despite the lack of legal obligation and regulation implementing greener ICT initiatives is about saving money and offering a better student experience. Also explain that as quickly as governments’ change, so too does their policies on environmental conservations and reaching carbon targets. Therefore operating more sustainably is akin to future-proofing and is best practice.

7.5.6 Performance of Green Technology.

Working closely with manufacturers of greener technologies, insist on evidence of savings from using their more sustainable kit. Where real savings are made and evidence of having a smaller carbon footprint can be quantified, sharing this information with stakeholders can help in overcoming the barriers.

7.5.7 Actions of Budget-Holders and Decision-Makers/Being Part of a Purchasing Framework.

Similar to point the made on how to overcome barriers to cuts in funding and the performance of greener technologies, providing evidence of savings from the use of more sustainable kit will help overcome the barriers of the short-sightedness of budget-holders and decision-makers. It will also help managers wishing to make greener ICT purchases whether or not they are part of a purchasing framework and whether or not green ICT is part of their framework. Once evidence is provided that the institution can save money without impacting on the student experience the barriers that is budget-holders and decision-makers can be overcome. Where savings and having a smaller carbon footprint can be quantified, sharing this information with the wider stakeholders can also contribute to overcoming the barriers. However, it is important to note that where too many barriers have been identified and there is strong indication that that the initiative will fail, initiatives should be scrapped or postponed or altered in some way to ensure a greater likelihood of success at a later date. This will avoid further wastage of institutional resources.

7.6 Recommendation for Policy-Makers to Overcome Barriers.

Recommendation for overcoming or avoiding the barriers given is in sections 7.5.1 to 7.5.7 apply mainly to FHE managers but can also apply to government policy-makers as well – both FHE sector policy makers and central government policy makers too. As government policy-makers are tasked with drafting new policies or amending existing policies, it's important they understand what the barriers to implementing ICT initiatives might be and how, as policy-makers, they can affect change. Moving forward, energy management policies and related carbon

management policies for both FHEs and central government should include a focus on green ICT and how to reduce its use. Government policy-makers, provisions of rewards and penalties that are related to reaching energy use reduction targets should be included. Policies and agreements' pertaining to environmental protection and sustainable best practice are signed with what appears to be mediocre-level follow-through on any of their commitments. Since 2010 the sector has been affected by reduced government funding and this has resulted in institutions making changes to ensure profitability, therefore drafting new policies pertaining to improved sustainable performance is no longer a priority. Policy-makers need to re-examine where they can save on spending but unfortunately ICT running costs appears *not* to be top of the list, when ideally it should. With no consistently strong government organisations acting as drivers to affect change, FHE institutions appear to be getting worse at being greener. However, where this research has identified barriers to implementing environmentally sustainable ICT projects in the FHE sector, most of those barriers can be overcome (Pinkse and Dommisse, 2009; Puritt, 2012). With sufficient budgets to recruit staff whose remit includes engaging with stakeholders in behaving more sustainably, green ICT initiatives stand a better chance of being successful (Estermann and Bennetot Pruvot, 2011; Papaspyropoulos, 2016). Chapter 4 and 5 demonstrated this in the outcomes of their survey results and in their key findings.

Chapter 8. Overall Conclusion to the Research: Sustainable Information and Communication Technology (ICT) initiatives in UK and Irish Universities and Colleges: Identifying and Overcoming the Barriers to Implementation.

This research concludes with a reflection on the research in its entirety. Conclusions are reached regarding bridging the gap in knowledge, and therefore contributing to knowledge, and improving the use of sustainable ICT within the FHE sector.

8.1 Review of the Research Aims and Objectives.

This research aimed at improving the use of ICT as an effective tool for a sustainable future in universities and colleges. Its associated objectives were: (i) to identify the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges implementing sustainable ICT initiatives; and (ii) to develop an ICT solution to overcome those barriers. It can therefore be concluded that the research's aims and associated objectives were achieved.

Seven barriers to implementation of greener ICT were identified and the ICT solution the ED web app was created as an aid to overcoming at least three of the barriers.

As the core aim of this research was to reduce ICT energy waste and associated CO_2 emissions and thereby save FHE institutions money in unnecessary ICT running costs, this research demonstrated this in detail throughout Chapter 6.

8.2 Statement of Contribution to Knowledge.

The original contribution to knowledge of this research (i.e. the overarching aims of this research) is the identification of barriers to implementing sustainable ICT initiatives in universities and colleges in the UK and the Republic of Ireland. Another contribution of this research is identifying key implication of those barriers and demonstrating how technology helped FHE institutions overcome some of those barriers to operate more sustainably. The three types of contribution made by this research include:

8.2.1 The Practical Contribution.

The impact of this research was the way in which it changed how universities and colleges operate. Since sharing the outcomes of this research, institutions are likely to ensure that stakeholders are fully engaged and committed to implementing green ICT initiatives throughout the duration of ICT improvements. This research has shown the importance of making clear the aims and objectives of sustainable ICT initiatives to all stakeholders in advance with each participant being clear about their role and the broader impact it has in improving their institution's sustainability. The effects of wasted time and public money will be highlighted and after recommendations are taken on board, significant carbon and cost savings will be made. This research will be made available to university managers at all levels and responsibilities, as its application is multidisciplinary and outlines the importance of stakeholder engagement in greening projects across campus. It will also be made available to managers of large institutions such as government bodies, SMEs etc.

8.2.2 Contribution to Research Paradigms, Methodologies and Methods.

The relative research levels reflected in the sequence of research paradigms, methodologies and methods used in this study proved to be effective components (Trafford and Lesham, 2008, pp. 93-94) for gathering the evidence required to identify the barriers and limiting factors to FHEs implementing sustainable ICT initiatives. The combination of positivistic and phenomenological paradigms incorporating inductive, abductive and deductive methodologies for each of the three different stages established the best possible environment for the successful completion of this research. The mixture of qualitative and quantitative research methods chosen covering comparative, correlative, evaluative, case study, action and social research which incorporated survey, questionnaire and semi-structured methods of gathering data proved ideal for gathering the necessary data which answered the research questions and ultimately bridged the gap in knowledge.

8.2.3 Theoretical Contribution.

The theoretical contribution to his research is firstly that the same set of seven barriers exist in FHE across the UK and Ireland albeit it to different extents and that each of those barriers underpin one another. A second theoretical contribution is that sustainable ICT in large organisations works in two ways; it can be more energy

efficient in delivering the means to communicate electronically and therefore reduce running costs and carbon emissions. Another way is in the message it contains when communicating electronically. This occurs when its asking stakeholders switch off and save money. In short, not only is the technology itself greener in its design and energy requirements to operate, it can be used to run the campus more sustainably. A third theoretical contribution is that ICT engages with stakeholders and in doing so allows them to operate more sustainably by playing their part in preventing further energy waste on campus. When this occurs it also acts as an aid to lacking managers who may be too time and resource poor to gather data pertaining to energy waste. This too saves money and in doing so overcomes the barrier of cuts in funding.

8.3 Rigour, Significance and Originality.

This research possesses each of the three essential aspects that are the requirements of a professional doctorate. This research is:

(i) Rigorous in that its data are robust and triangulated.

(ii) Original as no other researcher has gathered the same group of datasets, produced the same sets of results or analysed the datasets in the same manner.
Its ICT solution to overcoming the barriers, The Energy Detectives project, has never been created before, either at Goldsmiths or elsewhere.

(iii) Particularly significant to the sector, as it highlights the barriers to participation in sustainable ICT projects and offers an ICT solution to overcoming at least three of those barriers. It also highlights other aspects of FHE management that needs addressing if the sector is to continue reducing its carbon footprint.

8.4 Limitations of the Research.

Like all doctoral thesis, this research has limitations and areas of weakness. Despite the main UK and Irish surveys being circulated to an estimated 215 FHE managers, only 76 responses were received and 31 of those were left incomplete. More time to conduct in-depth face to face interviews with FHE managers would have further triangulated the data but time restrictions and other work commitments

meant that online surveys and phone interviews were the most practical option for both parties. The ICT solution (The ED web app) did not have as much time or funding spent on it as ideally it should have, particularly if a greater number of stakeholder engagement was what was required. Ideally, a 0.5 full time equivalent (FTE) role should have been created with the singular aim of achieving significant reduction in energy waste as opposed to being part of the SES officer's remit at Goldsmiths. This may have resulted in even greater energy savings via staff and student engagement. Finally, while SurveyMonkey proved to be a cost-effective and convenient tool for gathering data, too many FHE managers taking the survey at the same time exceeded the capacity of the website on an occasion and follow-on questions did not flow as they had been set up to.

8.5 Value Action Gap Analysis and Behavioural Change.

Research has shown that there exists a divide between what is known by people to be the responsible path to take when faced with a dilemma and their behaviour in practice. Known as Value Action Gap Analysis, it occurs when an understanding of the need for more sustainable behaviour exists, whereas essential actions that may result in improved behaviour does not (Barr, 2006; Derksen and Gartrell, 1993). Value Action Gap is not restricted to ICT projects. Similar findings occurred at the University of Limerick where results of staff and student questionnaires indicated the widespread reuse of scrap paper and double sided printing and copying, when in fact results of waste audits indicated the opposite. It was suggested that reasons for the value action gap included insufficient recycling facilities, lack of knowledge and information on the benefits of waste minimisation and a psychological approach to sustainability. Each are also similar barriers to participation in ICT projects (Barr, 2006; Derksen and Gartrell, 1993). This was also evident in both the Scottish and UK SUSTE-TECH projects. It was evident from the comments left and answer options chosen in both surveys. Results indicated that people chose to take the easier route rather than make the more "difficult" sustainable choice.

It can also be concluded that there is currently a shift in the paradigm of carbon management in the higher education system and that sustainability appears not to be as high on institutions' agenda as it was in previous years. Research carried out in 2016, on the Carbon Management Policy in HEIs in the UK, indicated that higher education institutions are "paying lip service" to sustainability (Mazhar, 2016). While many FHE institutions have a policy in place, a committee that addresses

environmental projects on campus and an environmental manager who oversees these projects, they still consistently fail to deliver on reaching their carbon targets. In addition, institutions appear to be making strategic decisions aimed at increasing student numbers and maximising the use of their estate while at the same time reducing running costs. It appears as though the same managers fail to understand that tackling energy use is by far one of the most cost-effective ways of ensuring a campus is financially sustainable or even profitable. However, such limitations are not unusual. Sustainable behaviour in non-domestic buildings is affected by organisational culture, departmental 'politicking', conflicting internal politics and business goals (Bull, Everitt, and Stuart, 2015b). The study carried out by Velazquez et al. (2006) explored some of the factors that obstruct the implementation of sustainable initiatives in higher education institutions and identified several failures. These failures included few institutions having sustainability in their mission statements and only slightly more (43%) having a sustainable policy, or at least planning to have a written commitment to support sustainability, at their respective campuses. Non-enforcement of environmental initiatives was another barrier identified within the same study. This lethargic, half-hearted attempt at reducing campus footprints appears to occur across the globe. Worsening the dilemma, straightforward behavioural changes can be anything but. Staff in large organisations are likely to resist change particularly where energy use is concerned, for a number of reasons, but any resistance can be overcome if a behavioural change/energy waste reduction campaign is properly managed (Fogarty, 2015; Boulton et al., 2017)

Six years after Cameron declared that his government was going to be the "greenest government ever" his successor as prime minister, Theresa May, "scrapped" the DECC and created a new Business, Energy and Industrial Strategy Department of which the DECC became a component (GOV.UK, 2016). While the remit of the DECC remained the same, there was speculation that the move indicated a diminished determination by the UK Government to reach carbon reduction targets (Vaughan, 2016). This is another example of government organisations as poor drivers being barriers for the use of greener ICT in FHEs.

8.6 Stakeholders Responsibility in Reducing Energy Waste.

The responsibility to reduce carbon emissions cannot lie solely within the remit of the management of FHE institutions. Government organisation and FHE funding

bodies need to start policing carbon targets by increasing pressures and incentives to do so. Since HEFCE are no longer the main source of funding for institutions, there is even less pressure to reach carbon targets.

In addition there is no real policing of carbon emissions except for the DECC and even then there is little credibility given to these regulations, as they appear to be overly complex and change too frequently (Mazhar, 2016). Even in July of 2016 as a new prime minster took office, the DECC was repositioned from being a separate stand-alone department to being a sub-department under the Department of Business, Energy and Trade (DECC, 2016b). This move suggests that the new administration considers climate change to be of a lesser priority for the UK than previously considered.

While savings are still a concern for many institutions, providing ICT systems that can deliver administrative services and facilitate the student experience is the extent of their requirements. Making their ICT system greener, is not. In fact, the “student experience” has become part of core business at FHEs and as this typically involves wider connectivity to the internet across campus, ICT systems are continually expanding to support this. In this respect their footprint is less likely to decrease despite there being an even greater need for it. There is also little or no motivation from staff to reduce energy. This is due to the fact that they are often overworked and feel underpaid (Guardian Work Blog, 2013), neither of which is conducive with being enthusiastic in their roles. In this respect, staff members become barriers themselves that are to be overcome rather than a resource to be utilized (Bull et al., 2014).

Senior departmental management also play a major role in carbon management as it is they who decide the departmental goals for the coming academic year. They can decide to adopt a greener approach to running their department, or to disregard sustainability, focussing entirely on increasing funding. However, the two are not mutually exclusive. Being sustainable is a simple way of keeping costs to a minimum, thereby saving money which is an increase in funding of sorts via an alternative route. However, some staff still fail to grasp this concept. This may be in part due to departments working in silo and staying focused on core business which for ICT or IT managers is keeping ICT systems and equipment in working order twenty-four hours a day.

A solution to this is to add sustainability to the remit of staff and to the core business of every institution. This is likely to increase staff engagement as they see it as part

of their daily workload which they are “being paid to do” and not just as a favour to the sustainability officer. Even with the creation of the Energy Detectives web app that was easy to use and offered an incentive for participation, stakeholders did not engage with its use to any significant extent, until they were paid to do so (see Appendix VII-VII.3). Possible solutions therefore, to ensure continued stakeholder engagement in use of greener technologies include an increase in salaries or a financial incentive of sorts for staff willing to take on additional environmental duties. Another solution is regular training sessions and workshops, highlighting the overall benefits of a more environmentally sustainable institution.

8.6.1 Green Champions in FHEs using Green ICT.

Despite the recent apparent decline in the importance of institutional sustainability and carbon management (Mazhar, 2016) there are still FHE staff members championing the environment who are keen to ensure that their institutions leave a lighter footprint. Membership of organisations like the EAUC and LUEG are growing year on year (EAUC, 2016b; EAUC, 2017b) and institutions actively participate in as many environmentally sustainable initiatives as their budgets and resources allow (Green Gown Awards, 2017). In addition, despite ICT’s own contribution to the demand on already scare resources, overall its utilisation as a means of measuring, monitoring and reducing energy has proved invaluable. The concept, referred to as “clean ICT”, is facilitating behavioural change and making the management of buildings, campuses and even cities more efficient (Bull, 2015a).

8.6.2 Staff’s Role in Tackling Energy Waste.

The crucial role staff play in reducing ICT related energy should be included in induction training of new staff. Sustainability in all its forms across campus should be included as part of a person’s continuous professional development (SustainabilityandCSRInsights, 2017; Allen, 2017) and staff should be rewarded for any extra greening activities, particularly if they can demonstrate real cost savings. Each of the barriers identified in this research is exacerbated and in some instances is as a direct result of insufficient funding. In fact, insufficient funding *may* be regarded as one of the greatest barriers to implementing sustainable initiatives in a large organisation. It also appears to underpin each of the other six barriers too. Sufficient funding on the other hand allows for additional resources to be used,

support staff to be hired and necessary equipment to be purchased (Jansen, 2003; FundingCentral, 2017; UniversitiesScotland, 2006; LUPC, 2013).

An article published in 2010 in *The Economist* entitled, *A Sea of Sensors,* contained the subtitle “Everything will become a sensor—and humans may be the best of all” (Herring, 2010). Herring was referring to the increasing use of sensors by humans to gather data. Echoing this sentiment, Crowley Curry, and Breslin, (2014) demonstrated that a reduction in energy use of 27% in a building was hypothetically possible by enabling “citizen actuators” i.e. people to interact with their environments and via the use of social media, namely Twitter, to communicate with other “citizen actuators” in preventing energy waste (Crowley, Curry, and Breslin, 2014).

Another example is “SeeClickFix” , a smartphone app that allows users to report broken streetlights or rubbish that needs to be collected. Similar to the UK *Love Clean Streets* free smartphone app, they are each examples of stakeholders engaging with technology for improved sustainability and at the same time data are used to inform larger institutional or governmental decisions (LoveCleanStreets, 2016; Bbits.co.uk, 2017). It is fitting then that the Energy Detective’s project engaged with stakeholders to report energy wastage as opposed to relying solely on the use of powerdown technology or on SEOs to switch lights and ICT equipment off.

8.7 The Continuous Existence of Barriers in FHEs.

Despite the most engaged staff in the wealthiest of institutions, barriers will always exist. 100% staff engagement in environmental initiatives, and coupled with active participation, is extremely unlikely. The findings of this research are supported by the findings of three other research projects carried out in similar fields. In 2015, research into barriers to implementation of Green ICT at higher education institutions in India was conducted (Suryawanshi and Narkhedeb, 2015). That research identified 10 individual barriers with lack of motivation and rationale for adopting green polices amongst the implementers being identified as the true barrier i.e. poor stakeholder engagement. Even in China, efforts to embed sustainability into the operations and curriculum of primary schools have been met with similar barriers. Outdated conventions of educators, shortages of equipment, finances and trained teachers and general poor sustainability in schools prevented the further development of “green schools” in China (Wu, 2002).

These there is a distinct lack of motivation of stakeholders and no sense of urgency or importance to implement green ICT policies, as being the “real” underpinning

hurdles in implementation of green ICT initiatives. This research will aid policy-makers in framing polices and strategies for sustainable ICT development, which will finally bring financial and environmental benefit to their stakeholders and beyond. Research conducted in 2002 at Tufts University added that several personal, interlinked barriers also existed in individuals. It suggested that pro-environmental behaviour existed in people who were already knowledgeable of environmental issues, took correct actions and strategies and understood that they could make a difference. They also exhibited a sense of responsibility and were committed to greener actions (Kollmuss and Agyman, 2002). Altruism, empathy and pro-social behaviour were also traits of pro-environmental behaviour. These are essentially the opposite of the barriers identified by Blake 1999. Blake's research suggested individuality (laziness, wrong person, disinterest) responsibility (lack of efficacy and trust, do not own property) and practicality (lack of time, money and information) as being barriers to sustainability. This was evidenced in responses to questioning of Goldsmiths' staff regarding their shortcomings in the use of the Energy Detectives web app (see Chapter 6 section 6.5.1, p.232). Blake also adds that social and institutional constraints act as barriers regardless of the individual's attitudes or intentions. Social, cultural and economic factors are both considered forms of internal and external factors where barriers are the individual and/or the organisation (Blake, 1999).

8.8 Recommendations for Future Research.

On reflection of the key outcomes of this research, the following recommendations for future research can be made.

1. Conduct further research into the benefits of stricter policing of carbon emission by government organisations for the FHE sector. This research should include examining the benefits of reversion to the issuing of fines for institutions that fail to reach their carbon targets by the agreed date or which cannot at least evidence having taken considerable actions towards reaching their carbon targets.

2. Examine how reduced energy consumption should be considered part of "core business" in the FHE sector. Where "core business" typically means maximising

funding from teaching and research, examining how saving money through waste preventative measures needs greater consideration and should be higher on the business agenda of every FHE institution.

3. Examination of stakeholder engagement in sustainable initiatives in large organisations and the extent of its variation from person to person. An examination into the mind-set of stakeholders should be included, and how ongoing staff training in tackling climate change should be central to this research.

4. Further research into the use of smartphones as a facilitator to reducing energy waste (and therefore carbon emissions) within large organisations should be conducted. This research should incorporate the use of sensors, apps and social media in gathering and sharing data and through continuous action research, demonstrate how real cost and carbon savings were achieved.

5. Similarly, to recommendation number four, further research should be carried out into examining where technological improvements need to be made in the design of apps and web apps in order to improve stakeholder engagement.

6. Research into the dynamics between certain barriers to sustainability. This should examine how and why exactly they underpin and therefore undermine, yet also support, one another in large organisations.

8.9 Concluding Remarks.

This research has identified seven barriers that FHE institutions face when attempting to implement greener ICT initiatives. It has also identified and examined the implications of each of the barriers and in doing so established how significant a barrier each of them are. Most importantly, this research has shown how, through the use of an inexpensive web app, energy waste can be reported thereby providing essential information to FHE managers that can be used to energy waste.

The use of smartphone technology appears to be the optimal way to engage with stakeholders, mainly because of the convenience it provides. However, despite its convenience stakeholders in large organisations are disjointed and this research has offered valid explanations as to why this is the case.

Rewarding staff is key to engagement but that even then only a small percentage of stakeholders will engage. Workloads and core job remit were key factors for poor stakeholder engagement, with not being willing to spend personal phone minutes on work-related tasks being they reason why they are reluctant to participate in tackling energy waste.

As technology has become engrained in our everyday lives, has made us more efficient in the workplace and interconnected it is undoubtedly the way forward to overcoming barriers and ultimately operating more sustainably.

As the government appears to be less concerned with reaching carbon targets (32% by 2020 in comparison to 1990 levels and 80% by 2050) and giving FHEs more autonomy in running their institutions, they are having to find clever and inexpensive means of being greener. Using ICT solutions web apps is one of the better ways.

The findings of this research can be applied to any organisation that employs waste reduction measured in an attempt to save money and reach carbon targets. Those organisations include SMEs, hospitals, schools, government organisations, local authorities and libraries.

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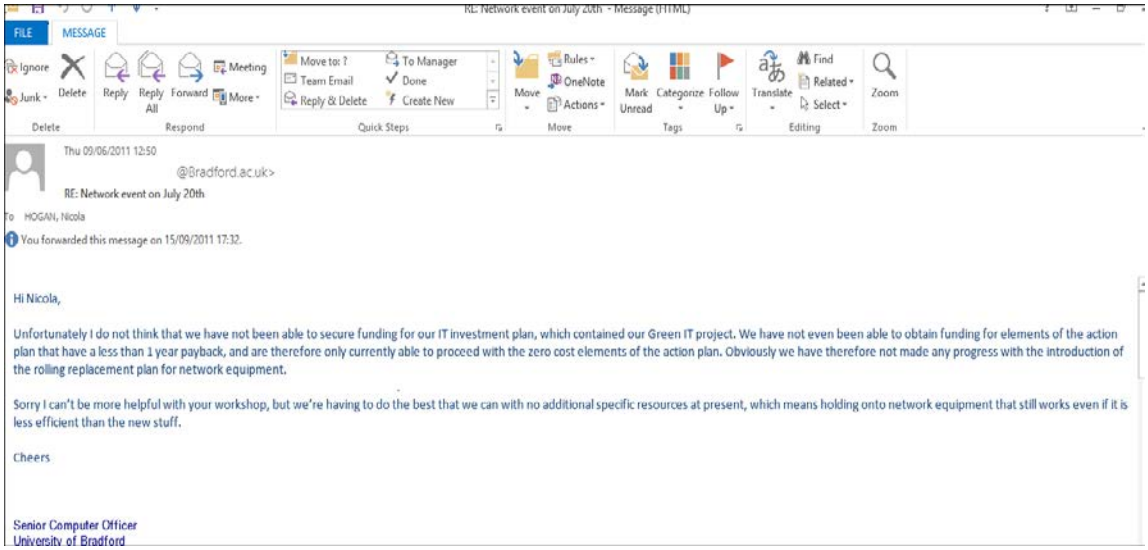
List of Appendices.

Appendix I. E-mail from a SUSTE-TECH participant stating that the university can no longer participate in the SUSTE-TECH project as they have not secured funding. (Dated 9/6/11).



RE: Network event on July 20th - Message (HTML)

FILE MESSAGE

Ignore Junk Delete | Reply Reply All Forward Meeting More | Move to: ? Team Email Reply & Delete To Manager Done Create New | Move Rules OneNote Actions | Mark Unread Categorize Follow Up | Translate Find Related Select | Zoom

Delete Respond Quick Steps Move Tags Editing Zoom

Thu 09/06/2011 12:50

@Bradford.ac.uk>

RE: Network event on July 20th

To HOGAN, Nicola

You forwarded this message on 15/09/2011 17:32.

Hi Nicola,

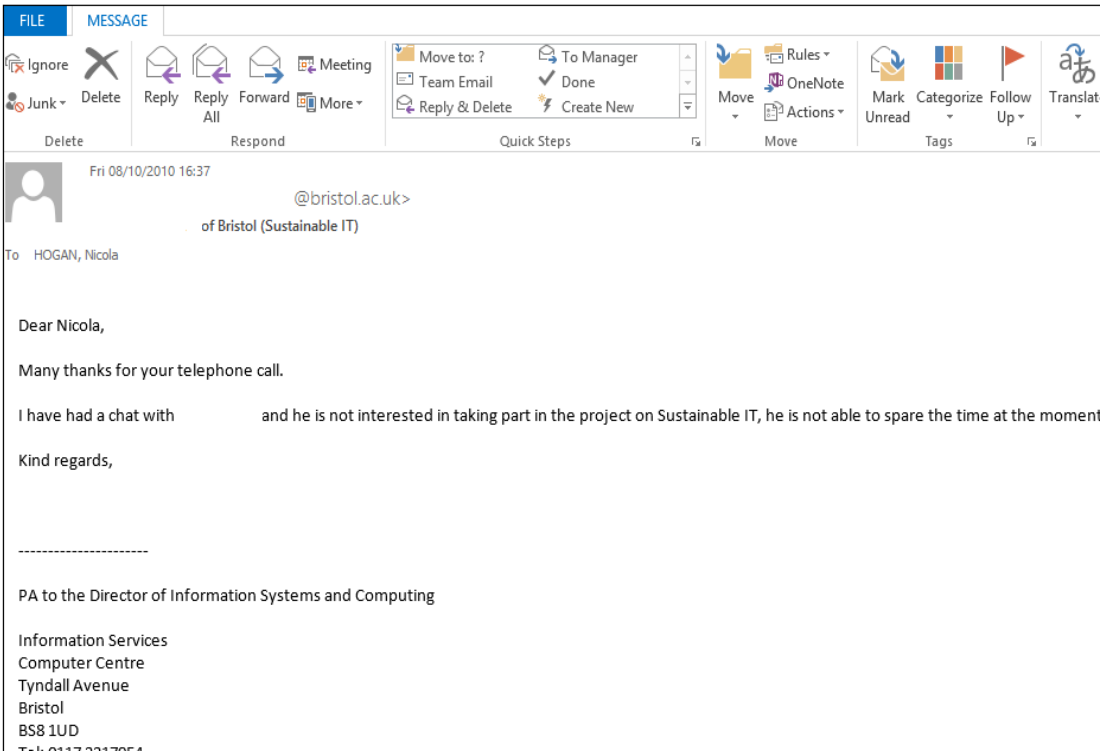
Unfortunately I do not think that we have not been able to secure funding for our IT investment plan, which contained our Green IT project. We have not even been able to obtain funding for elements of the action plan that have a less than 1 year payback, and are therefore only currently able to proceed with the zero cost elements of the action plan. Obviously we have therefore not made any progress with the introduction of the rolling replacement plan for network equipment.

Sorry I can't be more helpful with your workshop, but we're having to do the best that we can with no additional specific resources at present, which means holding onto network equipment that still works even if it is less efficient than the new stuff.

Cheers

Senior Computer Officer
University of Bradford

Appendix I.1 Email from SUSTE-TECH participant stating that their university will not be participating in the SUSTE-TECH project as the IT manager cannot spare the time (Dated 8/10/10)



FILE MESSAGE

Ignore Junk Delete | Reply Reply All Forward Meeting More | Move to: ? Team Email Reply & Delete To Manager Done Create New | Move Rules OneNote Actions | Mark Unread Categorize Follow Up | Translat

Delete Respond Quick Steps Move Tags

Fri 08/10/2010 16:37

@bristol.ac.uk>

of Bristol (Sustainable IT)

To HOGAN, Nicola

Dear Nicola,

Many thanks for your telephone call.

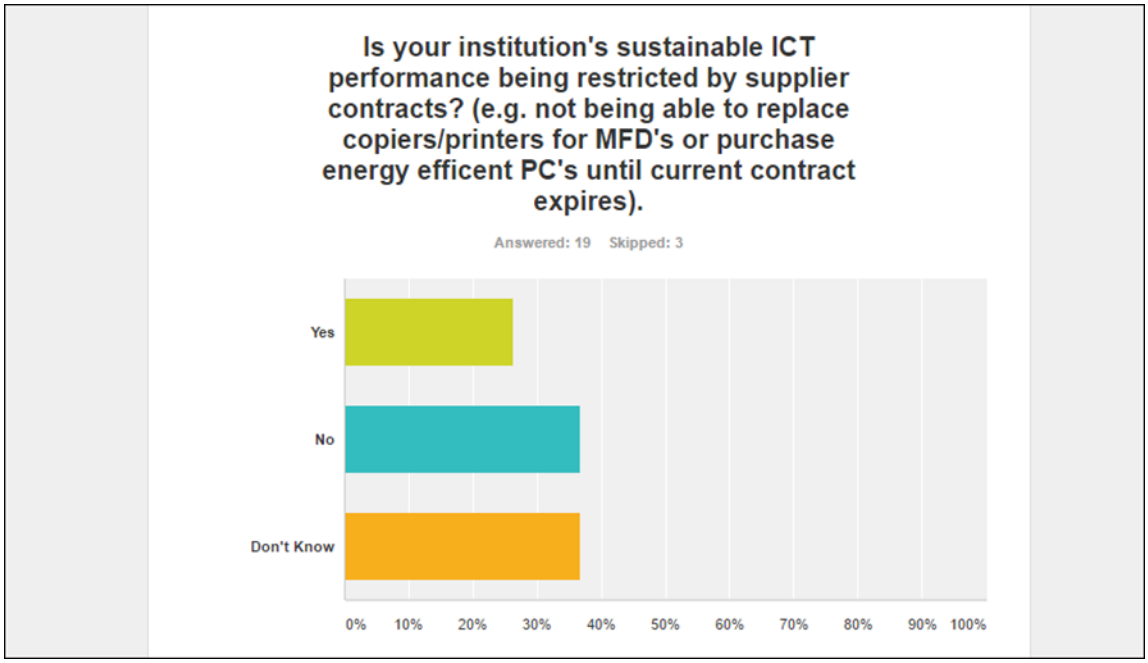
I have had a chat with and he is not interested in taking part in the project on Sustainable IT, he is not able to spare the time at the moment

Kind regards,

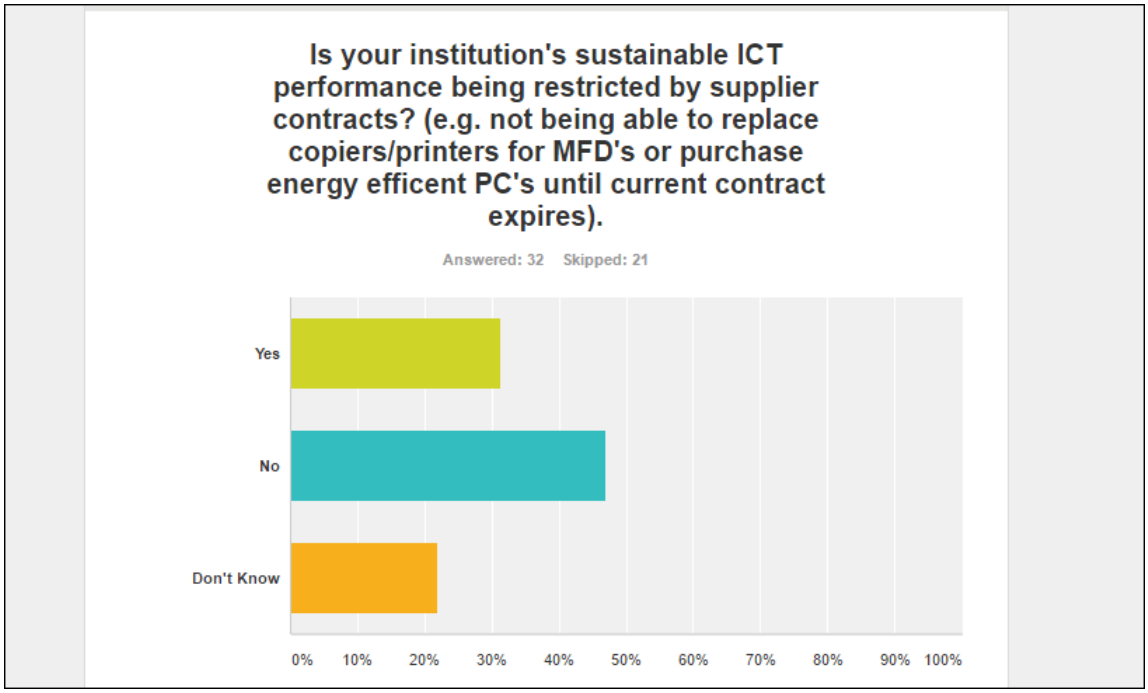
PA to the Director of Information Systems and Computing

Information Services
Computer Centre
Tyndall Avenue
Bristol
BS8 1UD

Appendix II: Results of Survey for Procurement for Green ICT by ICT Managers Survey indicating institutions restriction by supplier contracts thereby preventing them from operating as sustainably as possible.



Appendix II.1: Results of Procurement Managers Knowledge of Green ICT Survey indicating institutions restriction to conform to supplier contracts thereby preventing them from operating as sustainably as possible.



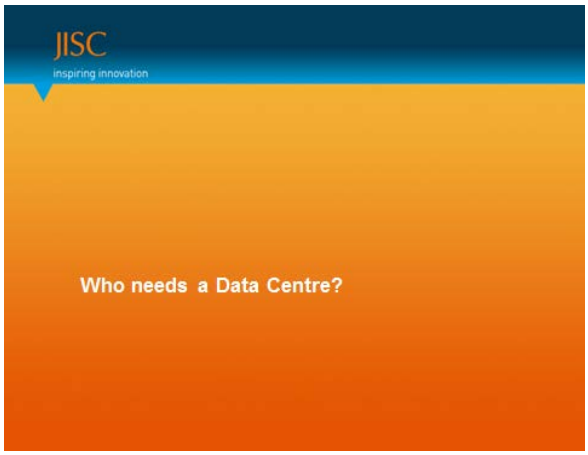
Appendix III; Abstract from Minutes of SUST-TECH Meeting explaining the revised requirements for participation in the SUSTE-TECH project.

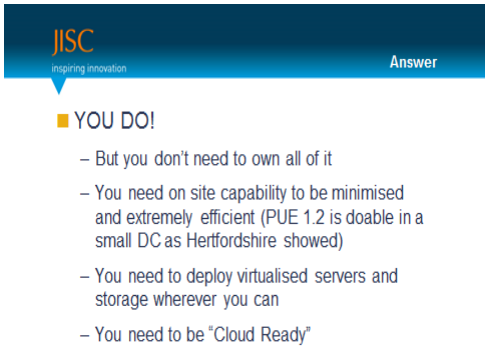
1. **Reasons for changes to original remit of the project:**
   NH explained to the committee how she recruited institutions from each of the 3 regions. She detailed the reasons for the slow pace of institution applying to participate and why as a result of such low numbers of applications by their respective deadlines, the remit of the project was changed.

2. **Updated list of SUSTE-TECH project participants :**
   NH circulated the list of 15 participating institutions to committee members. The list included the contact details and the type of documents each submitted as part of their application. The list also included the names of institutions that requested a place is held for them on the project but who have yet to submit any form of application document.

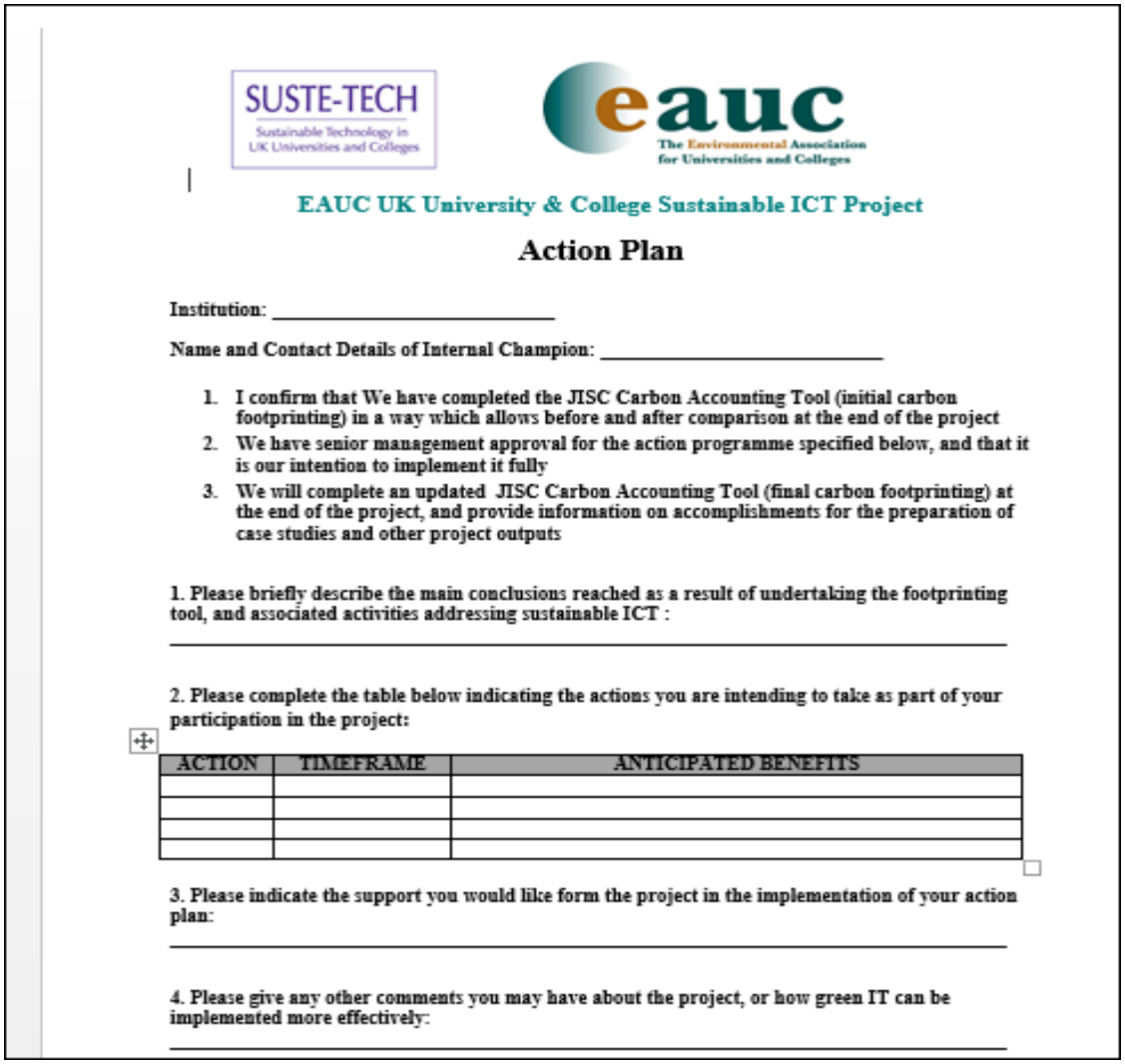
3. **Current remit of the SUSTE-TECH project:**
   NH gave details on the new remit of the project that allows institution to apply to participate without having to complete the Suste-IT Tool. Instead submitting an Action Plan only will suffice. The new remit also includes a greater emphasis on dissemination of best practice of green ICT and facilitation of the networking of FHE's implementing sustainable ICT initiatives.

Appendix IV: Who Needs a Data Centre? By John Milner, JISC Programme Manager, from the Maximising Your Data Centre's Efficiency Workshop Presentation, March 31st 2011.





Appendix V: Green ICT Action Plan.



SUSTE-TECH
Sustainable Technology in UK Universities and Colleges

eauc
The Environmental Association for Universities and Colleges

EAUC UK University & College Sustainable ICT Project

Action Plan

Institution: _____

Name and Contact Details of Internal Champion: _____

1. I confirm that We have completed the JISC Carbon Accounting Tool (initial carbon footprinting) in a way which allows before and after comparison at the end of the project
2. We have senior management approval for the action programme specified below, and that it is our intention to implement it fully
3. We will complete an updated JISC Carbon Accounting Tool (final carbon footprinting) at the end of the project, and provide information on accomplishments for the preparation of case studies and other project outputs

1. Please briefly describe the main conclusions reached as a result of undertaking the footprinting tool, and associated activities addressing sustainable ICT :

_____

2. Please complete the table below indicating the actions you are intending to take as part of your participation in the project:

ACTION	TIMEFRAME	ANTICIPATED BENEFITS

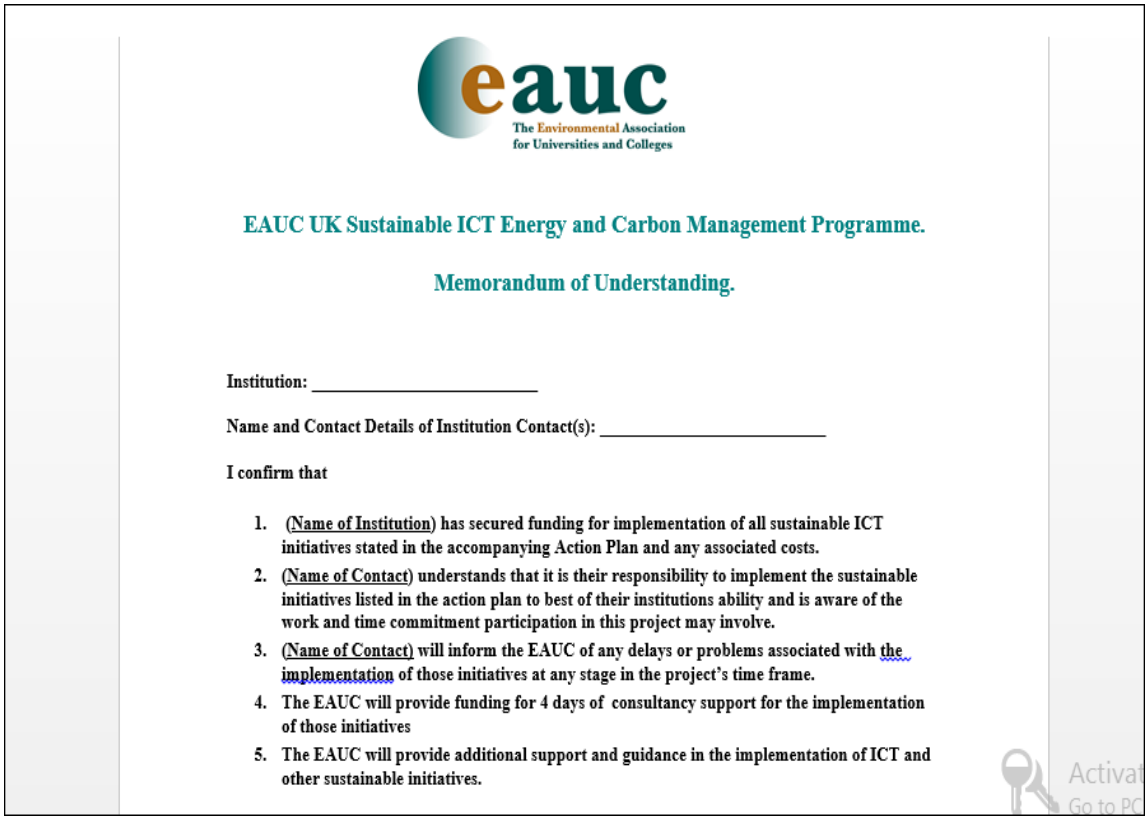
3. Please indicate the support you would like form the project in the implementation of your action plan:

_____

4. Please give any other comments you may have about the project, or how green IT can be implemented more effectively:

_____

Appendix VI: EAUC UK Sustainable ICT Energy and Carbon Management Programme Memorandum of Understanding.



eauc
The Environmental Association for Universities and Colleges

EAUC UK Sustainable ICT Energy and Carbon Management Programme.

Memorandum of Understanding.

Institution: _____

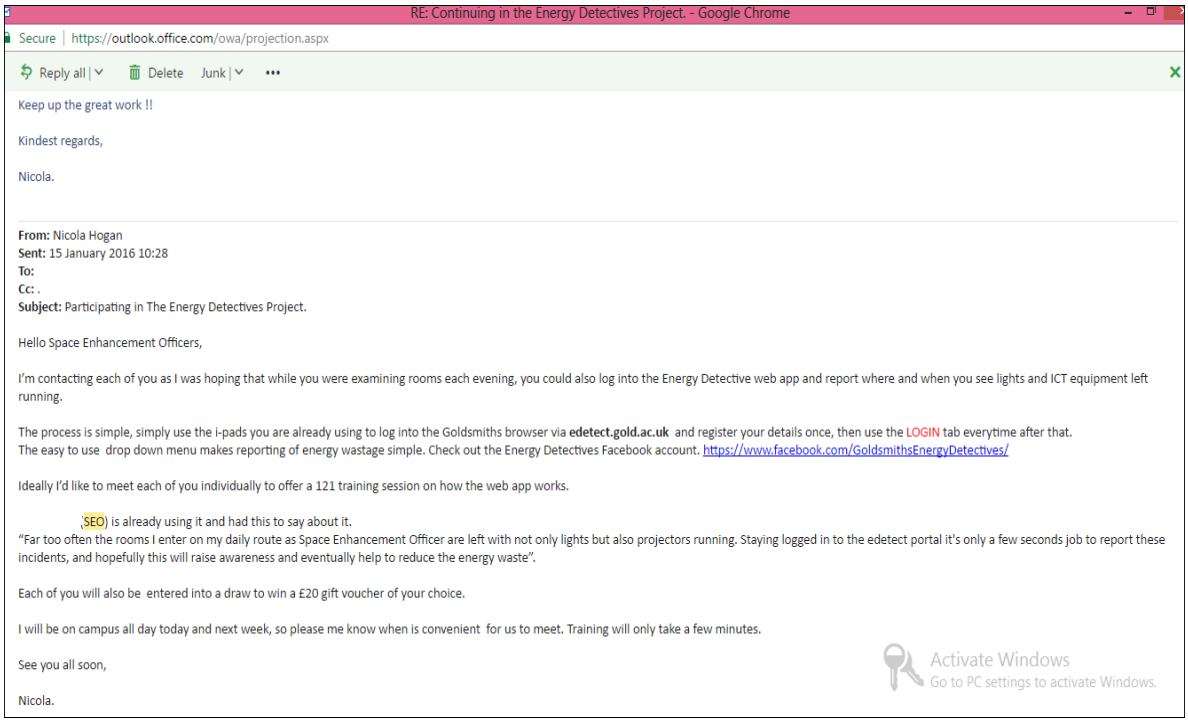
Name and Contact Details of Institution Contact(s): _____

I confirm that

1. **(Name of Institution) has secured funding for implementation of all sustainable ICT initiatives stated in the accompanying Action Plan and any associated costs.**
2. **(Name of Contact) understands that it is their responsibility to implement the sustainable initiatives listed in the action plan to best of their institutions ability and is aware of the work and time commitment participation in this project may involve.**
3. **(Name of Contact) will inform the EAUC of any delays or problems associated with the implementation of those initiatives at any stage in the project's time frame.**
4. **The EAUC will provide funding for 4 days of consultancy support for the implementation of those initiatives**
5. **The EAUC will provide additional support and guidance in the implementation of ICT and other sustainable initiatives.**

Appendix VII to VII.3 E-mails confirming the recruitment of SEOs to work as Energy Detectives.

VII.1



RE: Continuing in the Energy Detectives Project. - Google Chrome

Secure | https://outlook.office.com/owa/projection.aspx

Reply all | Delete Junk | ...

Keep up the great work !!

Kindest regards,

Nicola.

From: Nicola Hogan
Sent: 15 January 2016 10:28
To:
Cc: .
Subject: Participating in The Energy Detectives Project.

Hello Space Enhancement Officers,

I'm contacting each of you as I was hoping that while you were examining rooms each evening, you could also log into the Energy Detective web app and report where and when you see lights and ICT equipment left running.

The process is simple, simply use the i-pads you are already using to log into the Goldsmiths browser via **edetect.gold.ac.uk** and register your details once, then use the LOGIN tab everytime after that.
The easy to use drop down menu makes reporting of energy wastage simple. Check out the Energy Detectives Facebook account. https://www.facebook.com/GoldsmithsEnergyDetectives/

Ideally I'd like to meet each of you individually to offer a 121 training session on how the web app works.

,SEO) is already using it and had this to say about it.
"Far too often the rooms I enter on my daily route as Space Enhancement Officer are left with not only lights but also projectors running. Staying logged in to the edetect portal it's only a few seconds job to report these incidents, and hopefully this will raise awareness and eventually help to reduce the energy waste".

Each of you will also be entered into a draw to win a £20 gift voucher of your choice.

I will be on campus all day today and next week, so please me know when is convenient for us to meet. Training will only take a few minutes.

See you all soon,

Nicola.

Activate Windows
Go to PC settings to activate Windows.

VII.1

From: Nicola Hogan
Sent: 16 February 2016 17:09
To:
Cc:
Subject: RE: Participating in The Energy Detectives Project.

Hi again everyone,

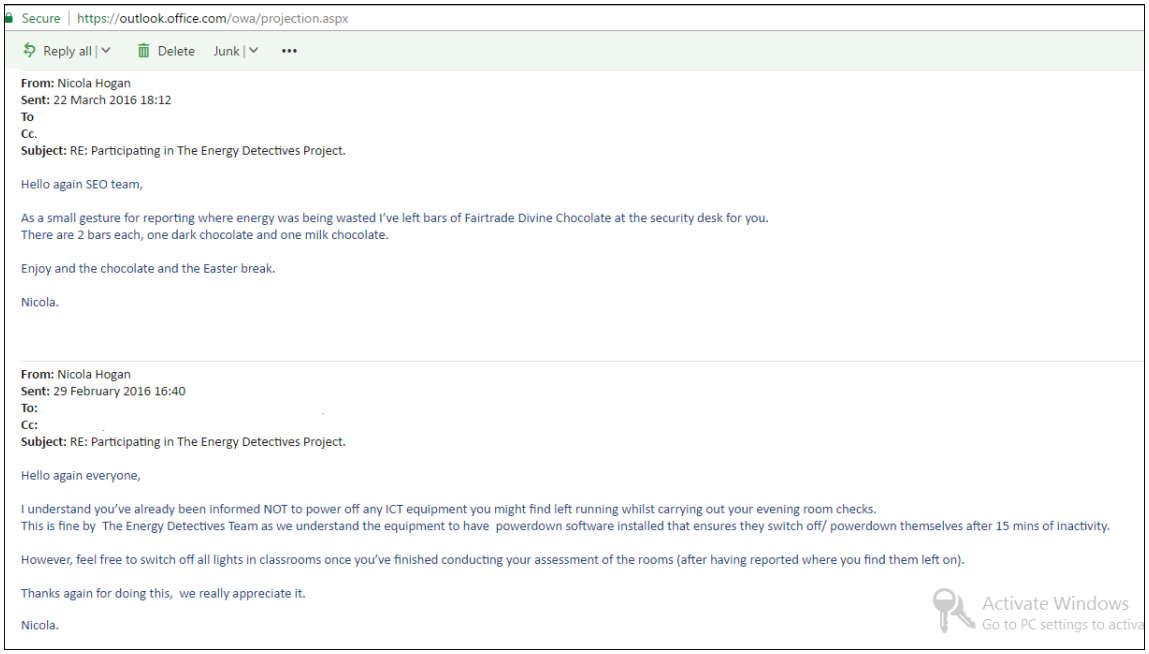
Just a quick email to say how much I appreciate you continually sending me in the Energy Detectives data.
Its proving extremely useful, and are now getting a clearer picture of where energy is being wasted across campus.

Keep up the great work !!

Kindest regards,

Nicola.

VII.2



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Reply all | Delete Junk | •••

From: Nicola Hogan
Sent: 22 March 2016 18:12
To
Cc.
Subject: RE: Participating in The Energy Detectives Project.

Hello again SEO team,

As a small gesture for reporting where energy was being wasted I've left bars of Fairtrade Divine Chocolate at the security desk for you.
There are 2 bars each, one dark chocolate and one milk chocolate.

Enjoy and the chocolate and the Easter break.

Nicola.

From: Nicola Hogan
Sent: 29 February 2016 16:40
To:
Cc:
Subject: RE: Participating in The Energy Detectives Project.

Hello again everyone,

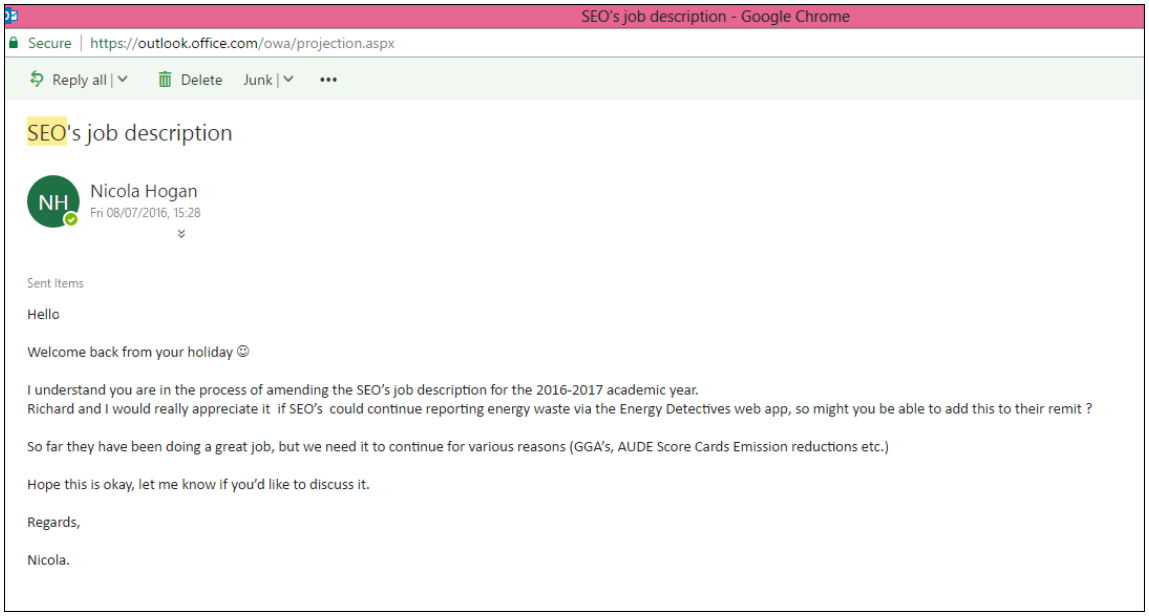
I understand you've already been informed NOT to power off any ICT equipment you might find left running whilst carrying out your evening room checks.
This is fine by The Energy Detectives Team as we understand the equipment to have powerdown software installed that ensures they switch off/ powerdown themselves after 15 mins of inactivity.

However, feel free to switch off all lights in classrooms once you've finished conducting your assessment of the rooms (after having reported where you find them left on).

Thanks again for doing this, we really appreciate it.

Nicola.

VII.3



SEO's job description - Google Chrome

Secure | https://outlook.office.com/owa/projection.aspx

Reply all | Delete Junk | •••

SEO's job description

NH Nicola Hogan
Fri 08/07/2016, 15:28

Sent Items

Hello

Welcome back from your holiday ☺

I understand you are in the process of amending the SEO's job description for the 2016-2017 academic year.
Richard and I would really appreciate it if SEO's could continue reporting energy waste via the Energy Detectives web app, so might you be able to add this to their remit ?

So far they have been doing a great job, but we need it to continue for various reasons (GGA's, AUDE Score Cards Emission reductions etc.)

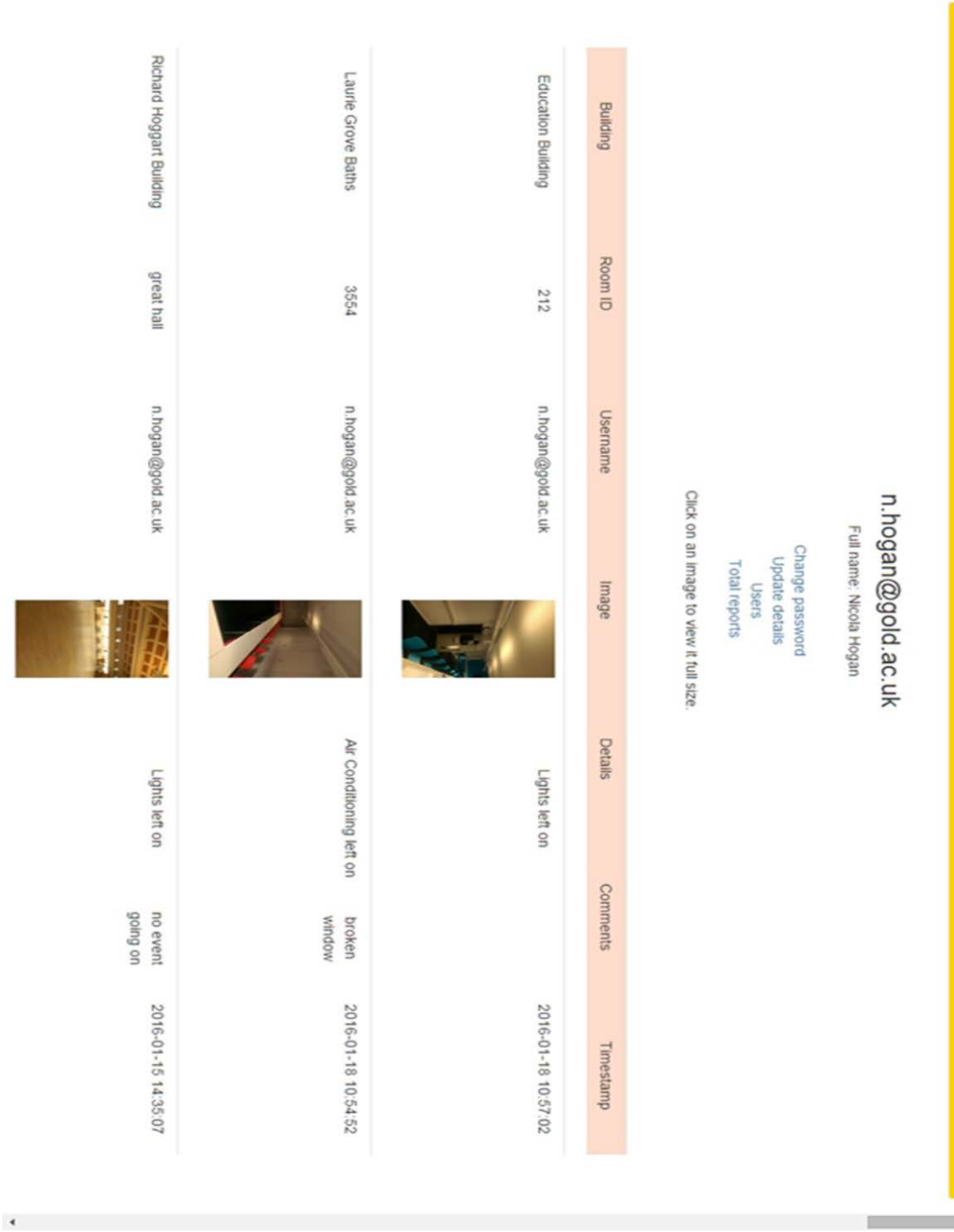
Hope this is okay, let me know if you'd like to discuss it.

Regards,

Nicola.

Appendices VIII.1– VIII.3 Format of how the Energy Detectives web app reports waste energy.

Appendix VIII.1: Energy Wastage reports via The Energy Detectives Web App Account.



n.hogan@gold.ac.uk

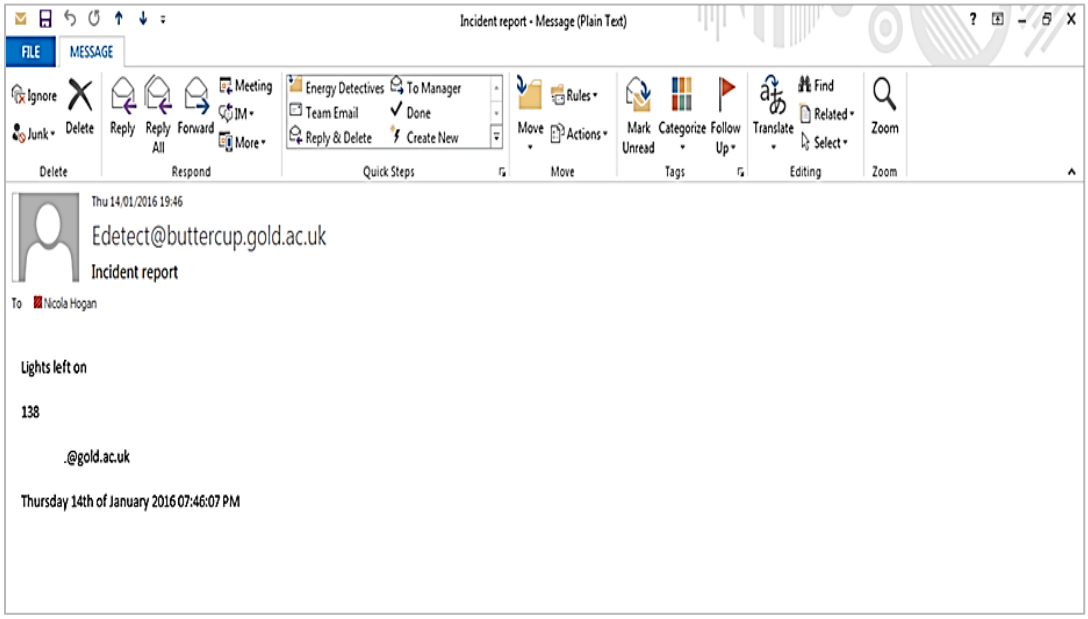
Full name: Nicola Hogan

Change password
Update details
Users
Total reports

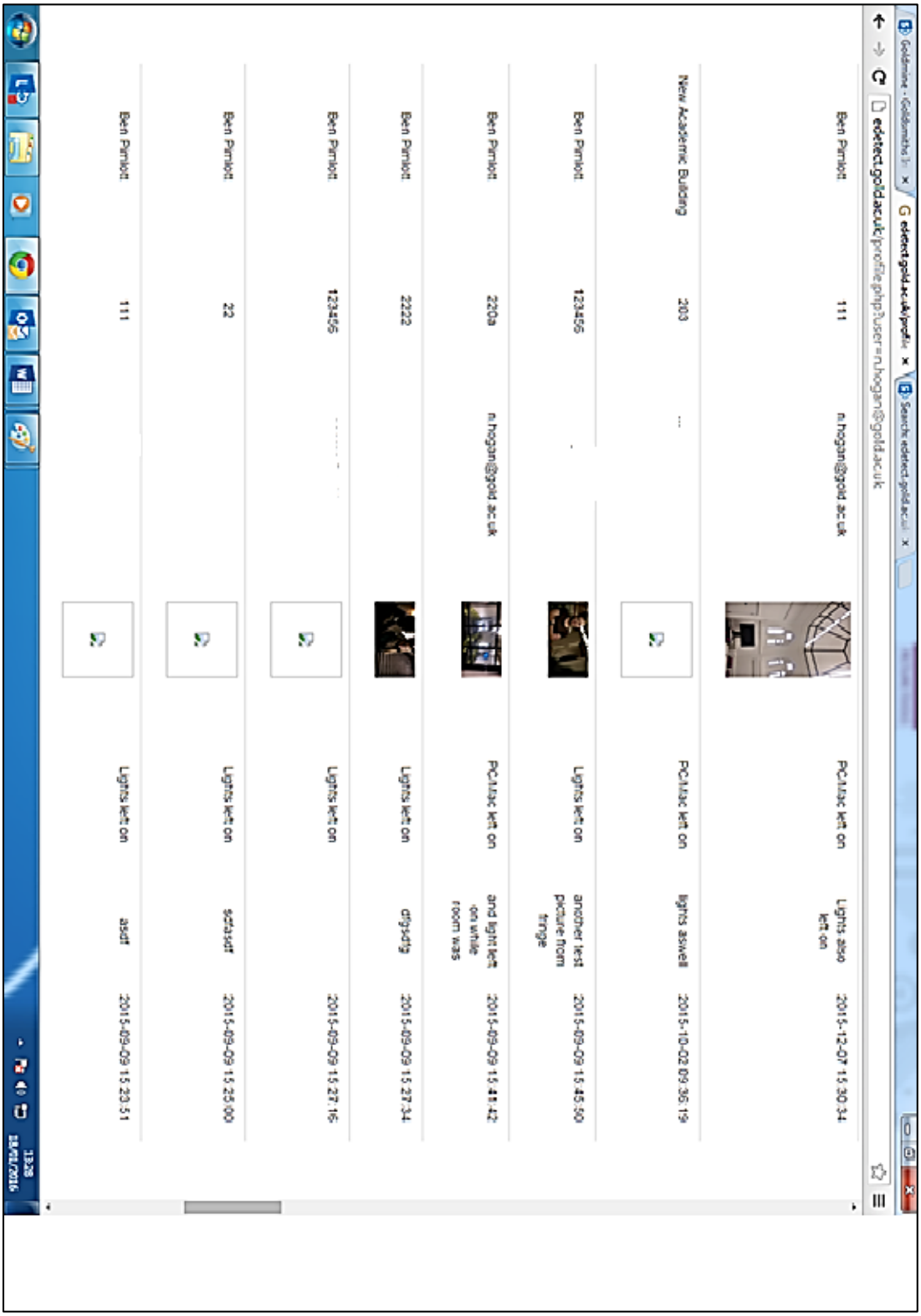
Click on an image to view it full size.

Building	Room ID	Username	Image	Details	Comments	Timestamp
Education Building	212	n.hogan@gold.ac.uk		Lights left on		2016-01-18 10:57:02
Laurie Grove Baths	3554	n.hogan@gold.ac.uk		Air Conditioning left on	broken window	2016-01-18 10:54:52
Richard Hoggart Building	great hall	n.hogan@gold.ac.uk		Lights left on	no event going on	2016-01-15 14:35:07

Appendix VIII.2: Energy Wastage reports via email to the Environmental Officer at Goldsmiths.



Appendix VIII.3 Energy Wastage reports via The Energy Detectives Web App Account.



Appendix IX: The Space, Environmental and Sustainable Officer's Update Paper for the Environmental and Sustainable Working Group's April 2016 meeting.

Appendix X. The Energy Detectives Project Logo and its association with the wider Greening of Goldsmiths.

(X.1)

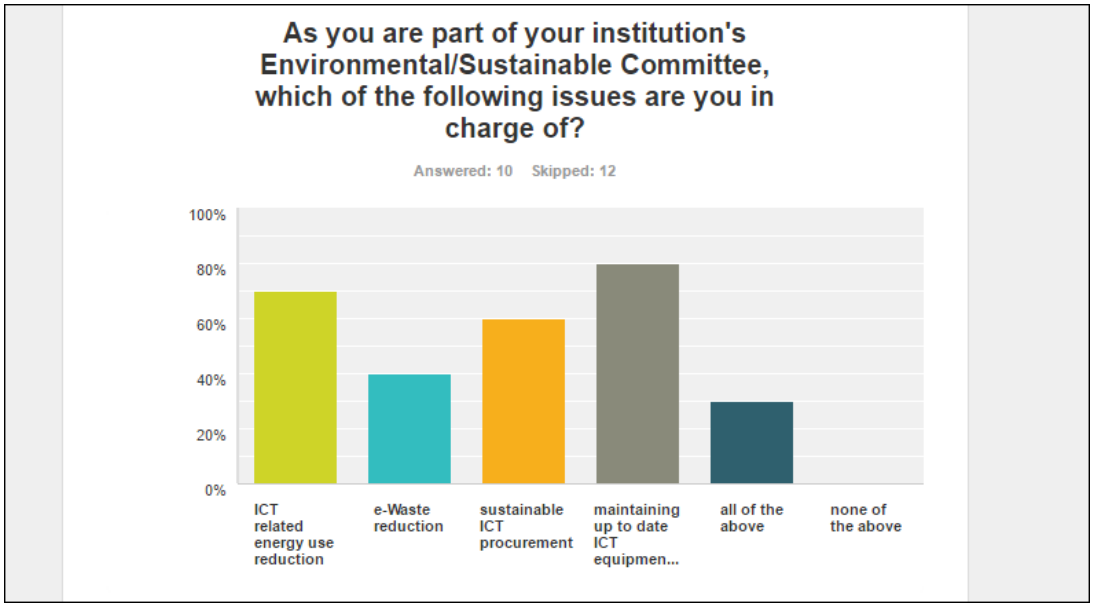
(X.2)

Appendix XI: The SUSTE-TECH Project Surveys.

Appendix XI.1 The Procurement for Green ICT By ICT/IT Managers Survey.

The Procurement for Green ICT survey was circulated in November of 2010 to ICT managers only. It aimed at establishing their existing knowledge of green ICT and also aimed at establishing if they were members of their institution's sustainable committee and contributed to making sustainable decisions regarding the purchase of ICT equipment. Similar to other surveys it established the background of the respondent as regards to their length of time working in their current roles, in the sector, their presence/absence on environmental committees and whether this was a request by the committee's chair or if was part of their job description. Respondents were also asked about their responsibility towards greening their institution's ICT systems to establish if it being on the committee could actually affect change.

Figure XI.1 Green ICT Related Issues Taken Charge of by Procurement Managers



86.36% (19) stated that their opinion was requested and 13.64% (3) stated that it was not. Of the 86.36% of respondents who said that it was, they are asked their opinion on a range of ICT kit. XII.2 and Table XII.3 summarise the types of technology on which ICT managers are asked for their opinion.

Figure XI.2 Categories of ICT Equipment ICT managers input is requested on.

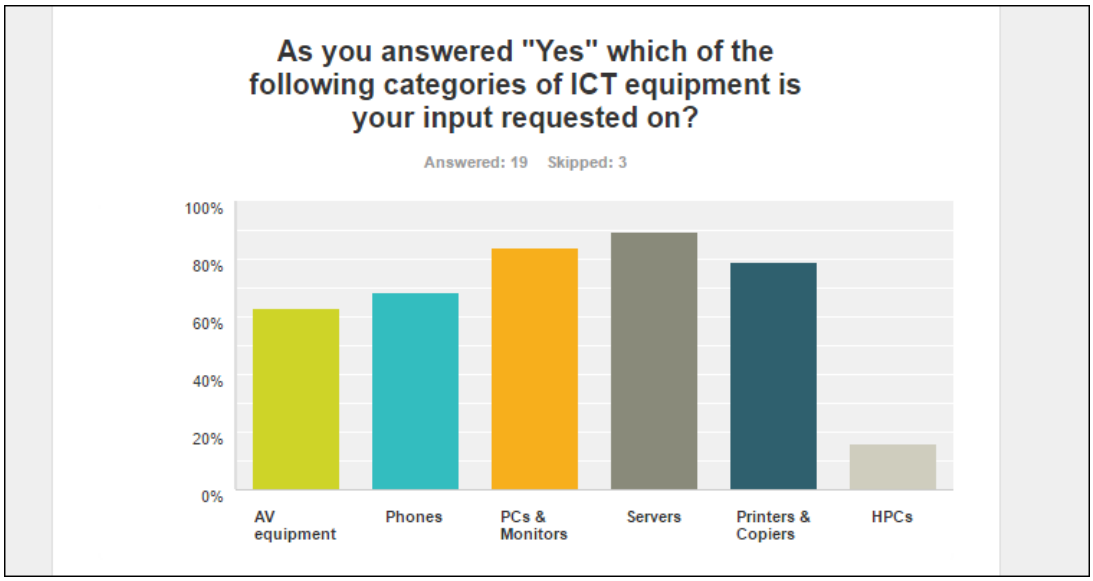


Table XI.1 Categories of ICT Equipment ICT managers input is requested on

Categories of Technology	Response Rate
AV Equipment	63.16%
Phones	68.42%
PCs and Monitors	84.21%
Servers	89.47%
Printers and Copiers	78.95%
High Performance Computers (HPC)	15.79%

82.35% (14) of ICT managers are asked for their input regarding the cost of purchasing new ICT equipment, the remaining 17.65% (3) are not asked. Strangely, when it comes to the energy requirements (kWhs) of ICT equipment only 35.29% (6) stated that their input is requested. The majority, 64.71% (11) of ICT managers are not asked for their input. When asked if they were aware of the "End Use Energy Services" directive requiring institutions to purchase equipment that is energy efficient in all modes, including in standby mode, 58.82% (10) of ICT managers

stated that they were and the remaining 41.18% (7) stated that they were not. However despite the somewhat conflicting results regarding ICT managers input into certain aspects of the purchase of ICT equipment for their institution, the majority of them 82.35% (14) are asked for their input regarding various other aspects of ICT equipment's use such as size, colour, performance and software compatibility. The remaining 17.68% (3) are not. Respondents were asked a series of questions regarding their institutions provision to them with sufficient information on advancements in greener technology including permission to attend Green ICT conferences, workshops, subscriptions to Green ICT journals and sustainable magazines. 70% (14) stated that they were and 30% (6) stated that they were not.

Respondents who replied *Yes* to the question regarding their institution's provision of information on advancements in greener technology, that information included 92.86% (13) attending Green ICT Conferences, 85.71% (12) attending Green ICT Workshops, 21.43% (3) Green ICT Training Events and 42.86% (6) Green ICT Magazines, Journal Subscriptions and Newsletters. For those who answered *No* to this question, the majority 83.3% (5) stated that they would be interested in information on greener technology with the remaining 16.67% (1) stating that they were unsure. The 78.57% (11) of respondents who answered "*Yes*" to the provision of information on greener technology also have an avenue that allows their knowledge of green ICT to influence their institutions decision process.

When asked about e-Waste, respondents stated that they were aware and not aware of the of ICT related packaging regulations to the same extent, i.e. 50% (10) for either response. When asked about ICT equipment packaging collection / take back services the response was mixed with 30% (6) stating they were satisfied, 10% (2) sating there were not and 60%(12) stating that they had no opinion on the matter. However 100% (20) of respondents indicated that their ICT suppliers complied with WEEE regulations (Waste Electrical and Electronic Equipment). Respondents also offered useful information regarding features and attachments most often disposed of and which they considered to be unnecessary as well as favourite categories of ICT equipment considered to be both user-friendly and better for the environment.

25% (5) survey respondents indicated that their institution used whole-life costing tools as part of their procurement process, 50% (10) indicated they did not and 25% (5) indicated they did not know. However, for those that answered "No"/"Don't Know" 80% (12) stated that they would be willing to consider using it in the future. The remaining 20% (3) stated they were unsure.

Finally, when asked about being aware of government targets relating to CO_2 emission reductions and energy efficiency, 85% (17) of survey respondents stated they were and 15%(3) stated they were not. Staying on the subject of carbon emissions, 64.71% (11) of respondents stated that their institution had set CO_2 reduction targets with 35.29% (6) stating that they had not. When asked specifically what their institutions' CO_2 targets were, comments included specific percentage reductions by set dates, comments that targets had already been achieved, not being sure what they were so having to look it up and institutions not yet having their targets agreed, but planning on it.

To summarise, this survey highlighted the disparity of knowledge and understanding ICT managers have regarding sustainable ICT and the benefits of its use. The majority of responses were positive and indicated that ICT managers in a variety of roles were aware of the environmental impacts the use of an ever increasing selection of "kit" causes. This survey also provided valuable information as regards the single category of kit that contributes to e-Waste and indicated that even managers who are not as actively green in their roles as they could be, are interested in changing this. Overall FHE institutions appear to have included their ICT energy consumption as part of their wider carbon and energy management plan and are on track to achieve their carbon targets (Hogan, 2011a)

Appendix XI.2: The Procurement Managers' Knowledge of Green ICT Survey.

Fifty-three procurement managers in total took part in the survey. This was primarily due to the survey being advertised to subscribers of the British Universities Finance Directors Group (BUFDG) mailing list, thereby reaching hundreds of procurement managers. The results proved extremely valuable to procurement policy-makers and FHE managers covering ICT, estates, energy and sustainability.

Overall, survey participants had an excellent background knowledge and experience in working, not only in their current procurement roles, but in the procurement sector in general. Almost half (47.7%) had worked for at least five years in their current procurement roles with almost 30% working in their current roles for up to fifteen years. 43.2% of survey participants had worked in the procurement sector for more than fifteen years with more than 40%, having between five and-fifteen years in the sector.

When asked about their knowledge of environmental /sustainable issues, almost 63% said that they were quite knowledgeable on the issue with almost 30% stating

that they were very knowledgeable on the subject. Less than 10% stated that they had minimal or no knowledge of sustainable issues. These results suggest that embedding sustainability into an institutions procurement process could be done with relative ease.

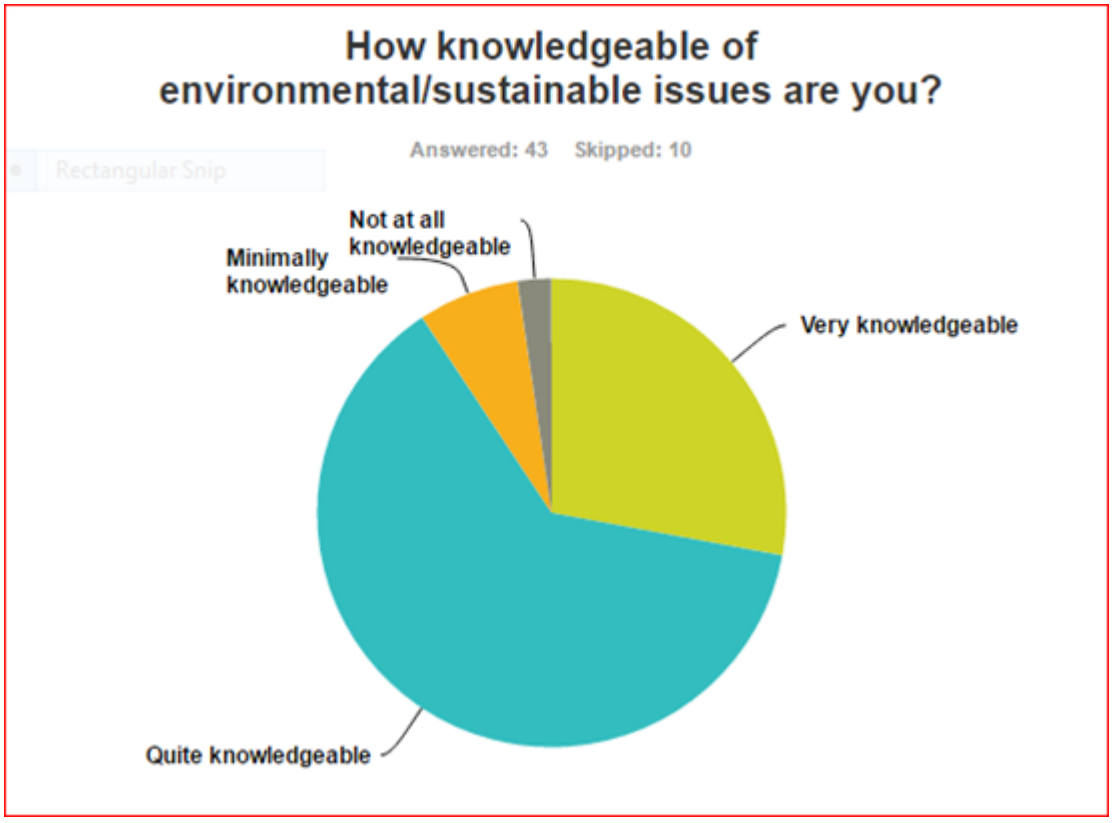


Figure XI.2 Chart Indicating Environmental/Sustainable knowledge of procurement staff.

When asked about their institutions' sustainable/environmental committee, 60% stated that they were part of it which means that 40% were not. Of those that were on the committee, more than half (52%) stated it was a voluntary decision. This indicated that staff were already dedicated to improving their institutions' sustainable performance. Other reasons included being asked to join (40%) and it being part of their job description (24%), indicating a sustainable mindset at a higher organisational level. When asked specifically about procuring for ICT equipment as part of their roles in the environmental committee, 60% of participants stated that they procured for energy efficient equipment, 40% stated they procured or tendered for e-Waste contactors, 48% stated they examined suppliers environmental credentials and almost 30% stated they examined the supply chain of ICT equipment. 24% stated they did all of the above with only 4% stating they did none

of the above. This indicated active participation by procurement departments in environmental committees.

Figure XI.2a Chart Indicating why staff are part of their institutions environmental committee.

For those who were not part of their environmental committee, 47% stated that it was because they were not asked to join, almost 12% stated it was because they did not have the time to join and 17.6% said it was because there was no such committee at their institution. These *Noes* could potentially be *Yeses*. However, based on the comments left as part of the *Nos* answers, as other procurement colleagues are part of the environmental committee so they are in fact represented in some way. Later when questioned about being asked to be on the committee, 75% stated they would join. The remaining 25% that answered *No*, indicating it was only because they felt they were already being represented or because of a lack of time: not a disinterest in environmental issues. To conclude, representation by procurement managers on environmental committees is particularly good. Separating the work done as members of environmental committees from their roles as procurement managers, almost 83% of survey participants stated that they procure for sustainable goods because it is part of their job description with almost 17% stating that they did not. Of the 83% that procure sustainably, they do it mainly for PCs and monitors, but they also procure for servers, imaging equipment and AV equipment and to a lesser extent HPCs and phones.

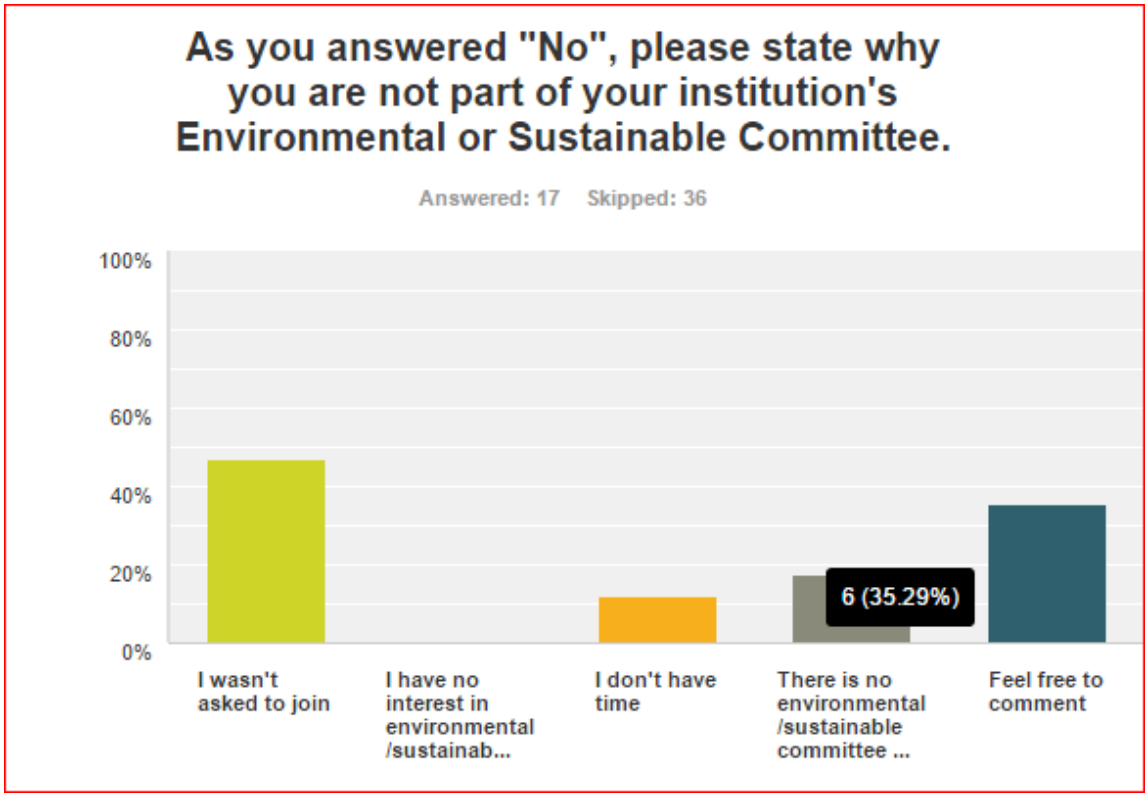


Figure XI.2b Chart indicating why staff are not part of their institutions environmental committee.

As part of their roles as procurement managers (as opposed to their roles in their environmental committees) 61% of survey participants said that they procured for more energy efficient equipment, 22% procure for e-Waste contractors, almost 40% procured for ICT equipment with a smaller EF and the same amount examined suppliers' green credentials. 22% examined the supply chain of ICT equipment while 33% did a combination of all the above. When asked if they were aware of the "End Use Energy Services" directive, half stated that they were while the other half said that they were not. These data indicated that the various aspects of green ICT are covered by procurement departments although not by everyone. When asked about being adequately provided with sufficient information on how to best procure for the most sustainable technology, 63% of survey participants said that they were, while 36.8% said that they were not. The comments on this question included: being restricted by time to attend workshops and conferences, their institutions currently working on this area and there being too much information to choose from, leading to indecisiveness. However 54.2% of survey participants stated that they had in fact attended green ICT training events/conferences and workshops, 50% had attended procurement training events conferences and/ or workshops and more than 45 %

subscribed to Green ICT magazines, journal subscriptions. The remaining 25% did all of the above with just 4% stating they were not being provided with any information on green ICT. However of those 4%, 92% stated that having access to greener technology was something they would be interested in, indicating a strong willingness to improve.

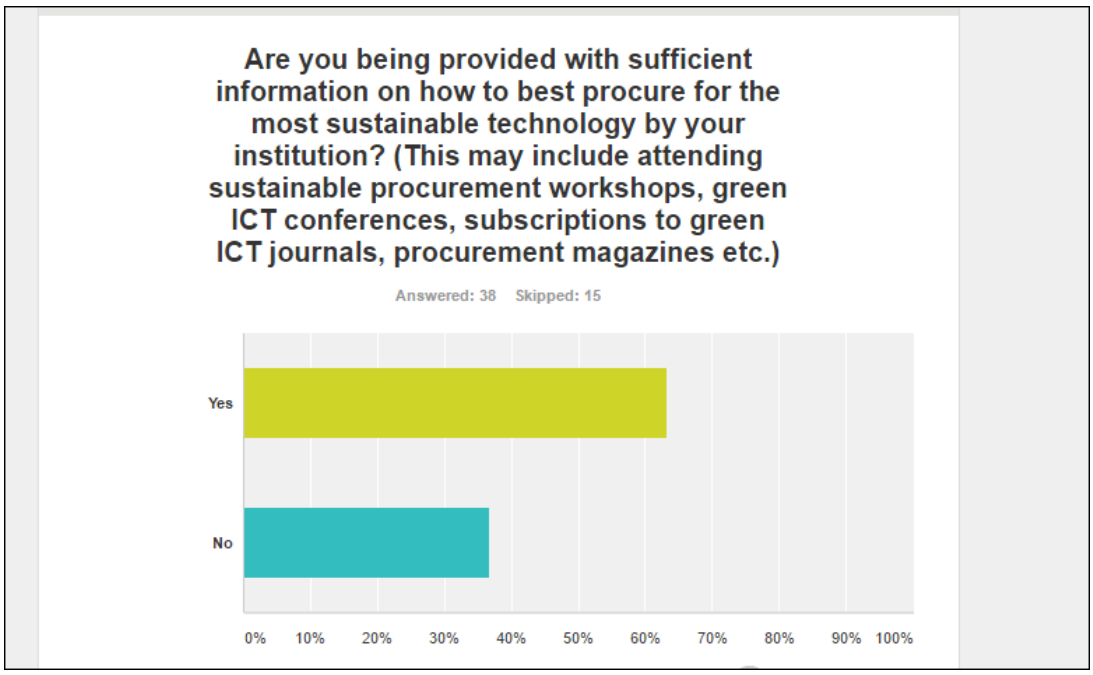


Figure XI.2c Chart Indicating Procurement Managers Provision with Sufficient Information to Procure for Green ICT.

91% of survey participants stated they were allowed to offer input into their institutions' procurement process with just less than 10% stating they were not. When asked about the use of tools, almost 64% of survey participants stated that procurement and whole life costing (WLC) tools were used as part of their institutions' procurement process, 22% did not, and the remaining 13.9% were unaware if their institution used a WLC tool or not. These data are illustrated in Figure XI.2. and comments on this question included WLC tools being too complex and inaccurate to get a true environmental footprint, (a topic that is often debated). Remaining comments covered institutions either already using WLC tools or being in the process of implementing the use of one.

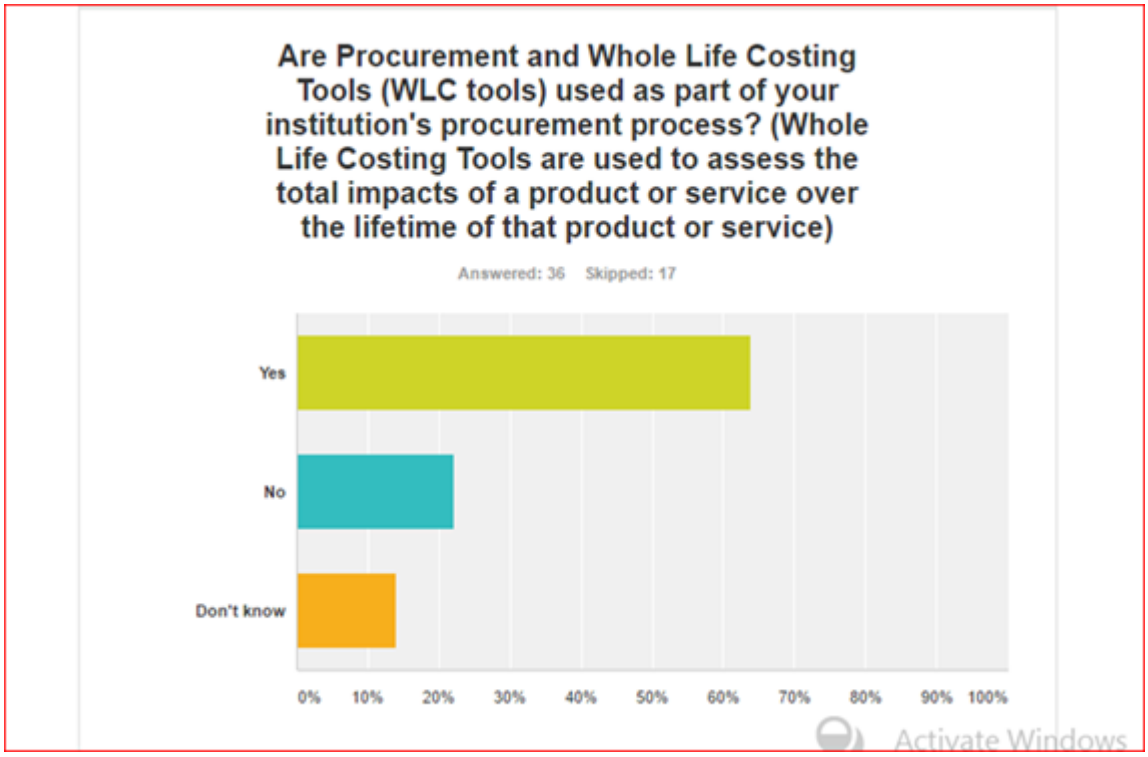


Figure XI.2d Knowledge of UK Institutional Use of WLC Costing Tools.

Of the WLC tools used, almost 37% of survey respondents stated that they used the SPCE flexible framework tool, 5.3% stated that they used the Forum for the Future's WLC and CO_2 tool. 47% stated that they use their own institution's specific procurement tool with 26.3% stating their use of another tool. Comments on this question included a list of other tools being used or simply using their own spreadsheet instead. However, of those stating that they were *not* using a tool, almost 79% stated they would be interested in using one. 7% expressed no interest and the remainder stated that they were unsure. Comments given as part of this question included: the possible use of a tool providing it was accurate and easy to use. 79% of those that stated that they used the HE procurement framework tool, felt that it covered their needs for sustainable ICT while more than 20% stated that it did not.

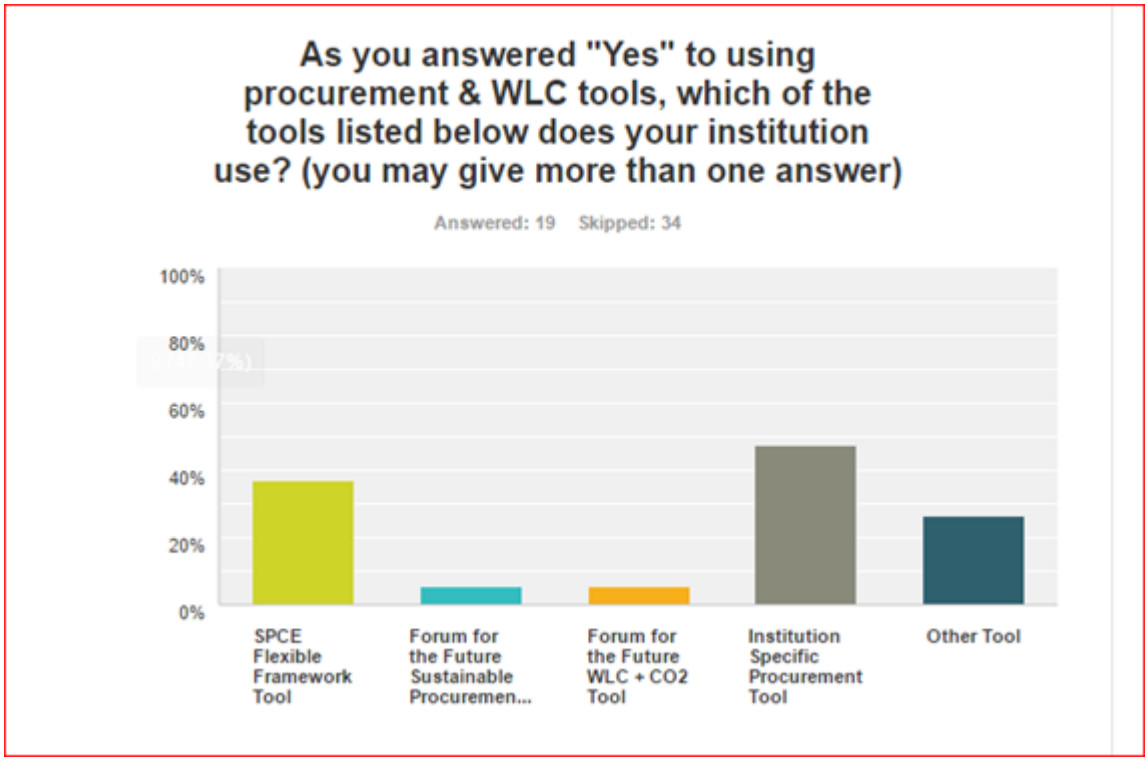


Figure XI.2e Chart indicating which procurement and WLC tools used at their institution.

On the carbon emission and energy efficiency question, almost 85% stated that they were aware of the related government targets with more than 15% stating that they were not. Of the 20 that answered *Yes* to monitoring their emissions, 16 replied with exact figures, the remaining stating that their energy or sustainable manager had the figures. This echoes the results of some of the earlier questions that indicated procurement managers' strong knowledge of sustainable issues and their willingness to champion the cause. When asked about suppliers' restrictions, more than 31% stated that they were being restricted with almost 47% stating they were not. Almost 22% stated that they did not know. Of those who answered *Yes*, they indicated that it was predominantly photocopier and printer contractors who restricted their ability to be more sustainable. The remaining answer options of PCs and monitors, AV equipment, telephones, networks, server room equipment, HPCs and other ICT equipment had an evenly distributed percentage of between 10% and 30%.

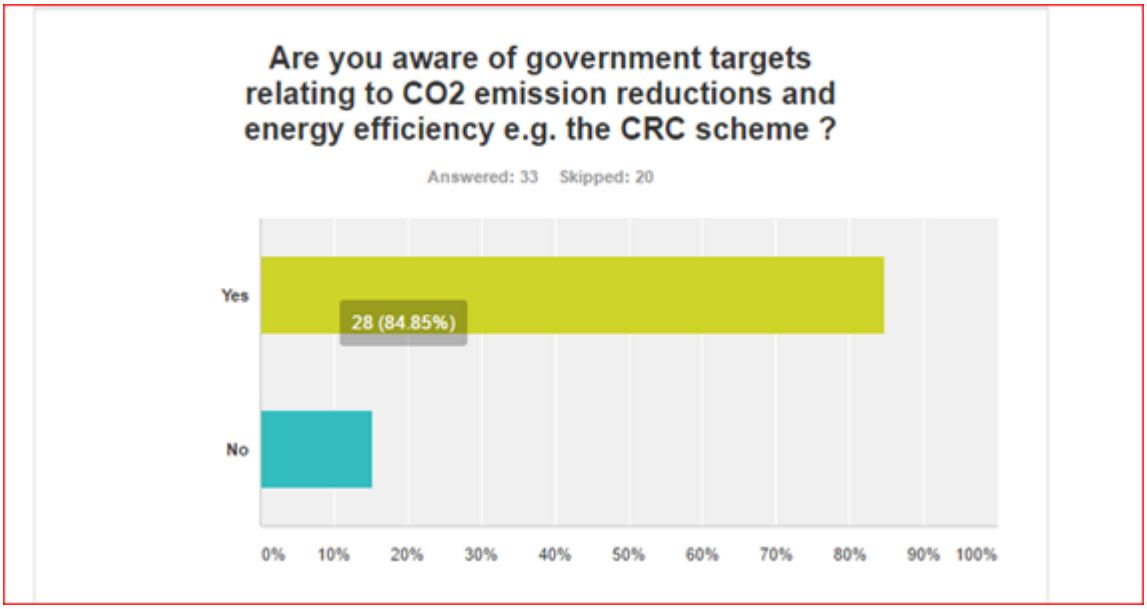


Figure XI.2f Chart Indicating staff awareness of targets relating to CO_2 reduction.

When asked how they measured value for money when procuring for sustainable ICT, thirty-one survey participants replied via leaving a comment. To summarise the thirty-one responses left, respondents stated that measuring the overall value for money of each piece of kit included: examining the initial purchase cost; ongoing running costs; and disposal costs. Items that live up to the standards and specifications that are the least expensive, are the items of better value.

When asked what kind of changes to the traditional procurement progress they would like to see made, thirty participants gave a variety of answers, but most had overlapping points. Those points included: procurement managers being able to see sustainability embedded more in WLC tools; less complicated tools being used; an ease on the EU procurement restrictions with more flexibility to purchase from local suppliers thus improving carbon footprint. In short, survey participants were in favour of anything that would make the procurement process less laborious and complicated and that would also promote and support sustainability. Overall, the survey indicated a very good background knowledge of sustainable issues from procurement managers and a strong presence on environmental committees. When procuring for ICT equipment the most important factors such as energy use and the life length of a product were examined. This is not surprising, as obtaining value for money goes hand in hand with sustainability. However, some of the responses

indicated scope for improvement and frustration at the often complex procurement processes.

The results and especially the closing comments, from this survey will hopefully prove useful when rethinking the procurement process.

Appendix XI.3: The Green ICT Strategy Survey.

This survey was circulated at the start of the SUSTE-TECH project to establish to what extent FHE institutions across the UK had a green ICT strategy, or similar, in place.

58 respondents in total took part in this with a wide variety job roles being represented from both FE and HE institutions. Respondents were asked if their institution had an ICT strategic plan (also known as an ICT Action Plan) in place and replies indicated that 57.89% (33) of institutions had while just over 7% did not. The remaining 25.09% (20) did not know whether their institution had or not.

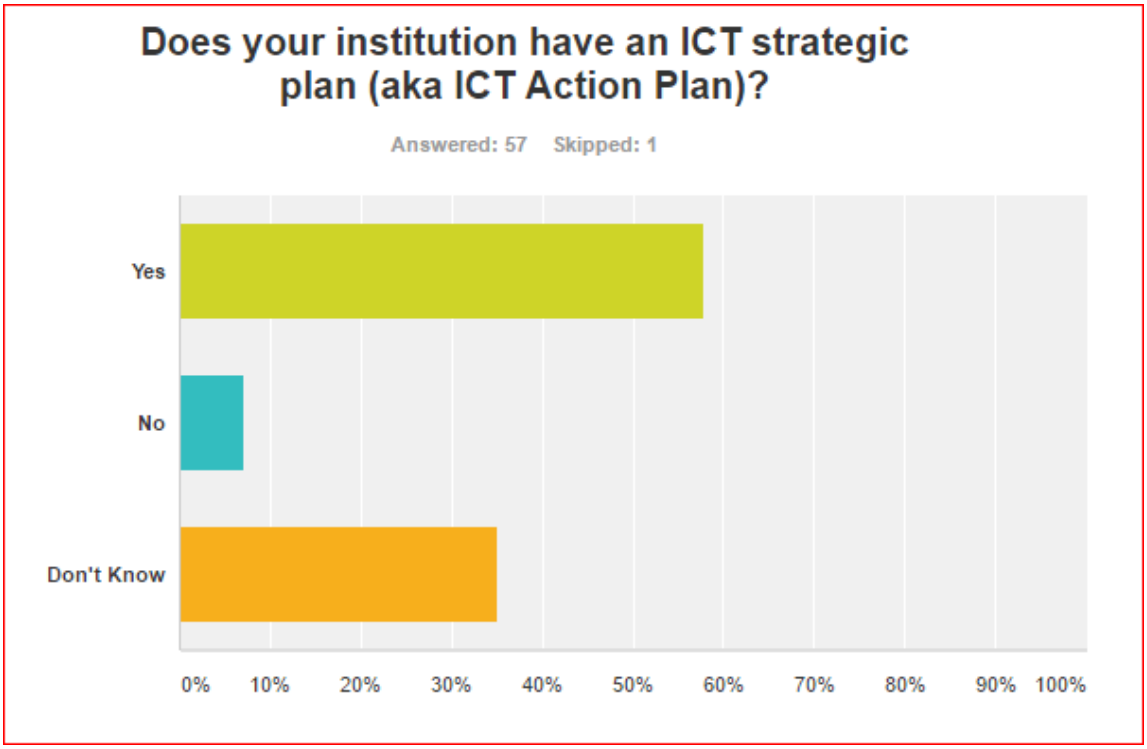


Figure XI.3 Chart indicating responses to question regarding ICT strategic plan.

Of those who answered *Yes* to having an ICT strategic plan, the respondents were asked if their ICT action plan included a green ICT strategy that included targets to

reduce environmental footprint of ICT operations. These responses are illustrated in Figure XI.3a. 60.61% (20) said it did and 21.21% (7) said it did not. The remaining 18.18% were unsure. For the respondents that replied *Yes* to the follow-on question having a green ICT strategy, 58.62% (17) said the plan included strategies for using ICT to help achieve sustainability targets and 10.34% (3) said that they did not. The remaining 31.03% or (9) stated that they did not know.

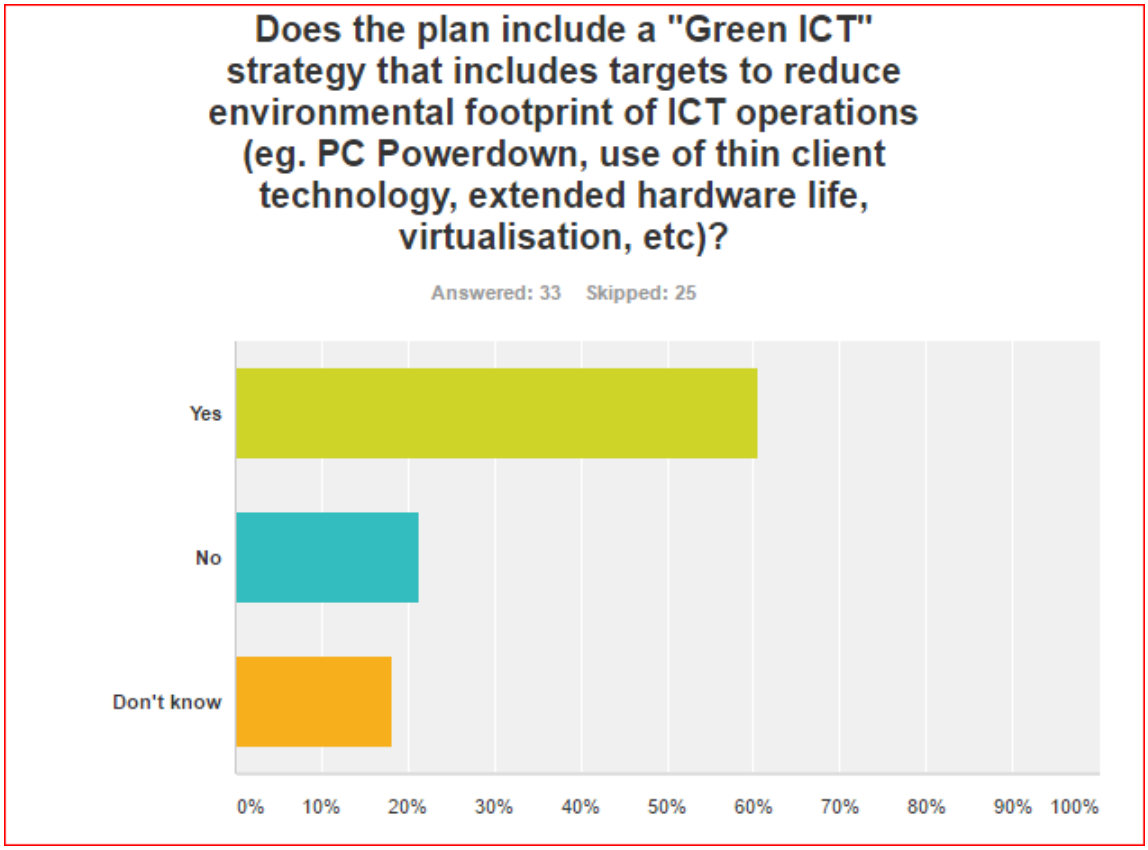


Figure XI.3a Chart indicating responses to Green ICT Plan including targets to reduce environmental Footprint of ICT.

Of those respondents who answered *No* or *Don't Know* to the previous question, 61.11% (22) stated that their institution used ICT to help achieve sustainability targets, 11.11% (4) and 27.78% (10) said that they did not know. Finally, respondents were asked if their institution specifically measured the carbon footprint of its ICT infrastructure specifically naming the SusteIT Tool as an example. 21.57% (11) said they did, 45.10% (10) stated that they did not and 33.33% (17) stated that they did not know if their institution did or not. To summarise, while this survey does not specifically highlight the presence or absence of barriers in institutions, it offers

an insight into the presence or absence of a green ICT strategy and action plan as part UK FHE institutions wider carbon management plan.

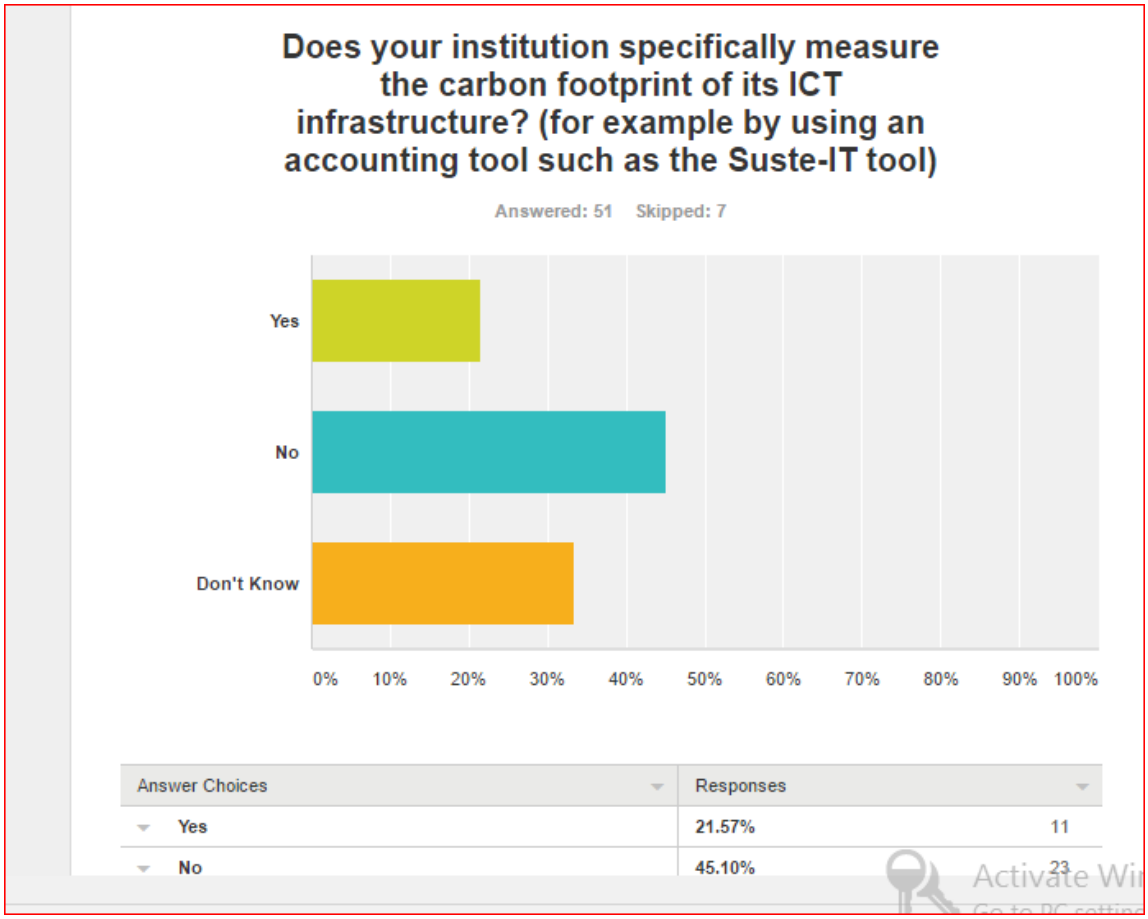


Figure XI.3b Chart indicating responses to Institutions Measuring the Footprint of ICT Infrastructure.

Appendix XI.4: Results of the Effects of Cuts in Funding Survey.

The Cuts in Funding Survey, circulated in January of 2012, had similar aims except that it was circulated to the full spectrum of university and colleges managers. The aim of this survey was to establish if the 2010, £600 million cuts in funding to the education and research budget as recommended in the 2009 Browne Review (Browne, 2010) had affected institutions' ability to operate more sustainably and therefore participate in the SUSTE-TECH project. Results of the survey were published in April of 2012 and are detailed below.

The survey was circulated to almost a thousand members of staff at various UK FHEs. One hundred and thirteen FHE managers participated in the survey with seventy-four of those managers (65.5% of total participants) completing the survey. Participants in the survey represented a variety of backgrounds and their responses

spoke volumes about the effects that cuts in funding were having on sustainable projects at FHE institutions. The following is a summary of those responses.

The percentage of respondents by job role is shown in Figure XI.4. The majority of survey participants (36.7% or thirty-three managers) were sustainability or environmental managers, with ICT and energy managers coming second and third, accounting for 18.9% (17 managers) and 16.7% (15 managers) of the participants, respectively. Procurement managers and Building and Estates managers also participated in the survey, as did waste managers and those working in Other departments. Unfortunately, neither carbon managers nor utilities managers were independently represented, although their roles may have been represented within one of the various job titles. Forty-six of the survey participants (51.1%) had at least one to five years' of experience in their roles with the remainder having at least six or more years' experience, so responses can be considered particularly valuable.

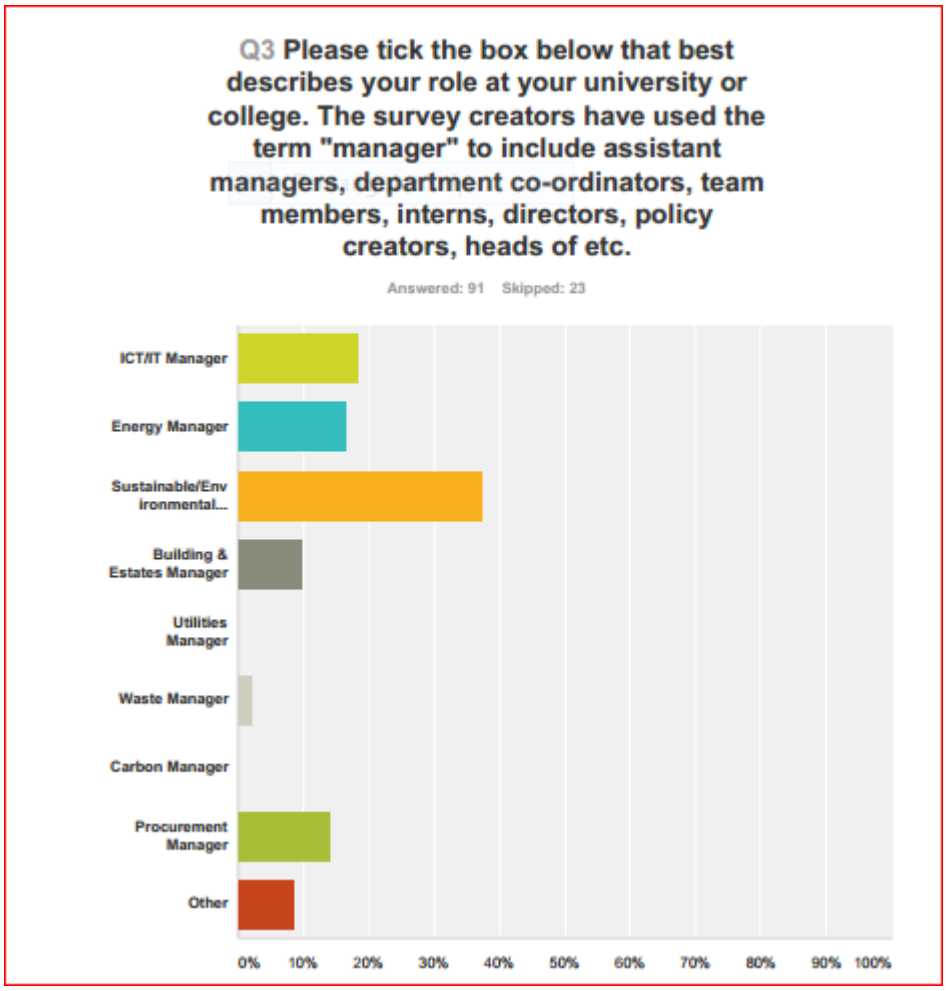


Figure XI.4 Chart indicating categories of job roles of survey respondents.

More importantly, however, the survey confirmed the effects which the 2010 cuts in funding had on the sector. Results of the survey indicated that seventy-two institutions (80.0% of survey participants) had their funding cut since 2010 with just five institutions (5.6% of survey participants) stating that their institution had not. The remaining thirteen institutions (14.4% of survey participants) stated they were unsure whether their funding had been cut or not, indicating no impact on their job roles thus far.

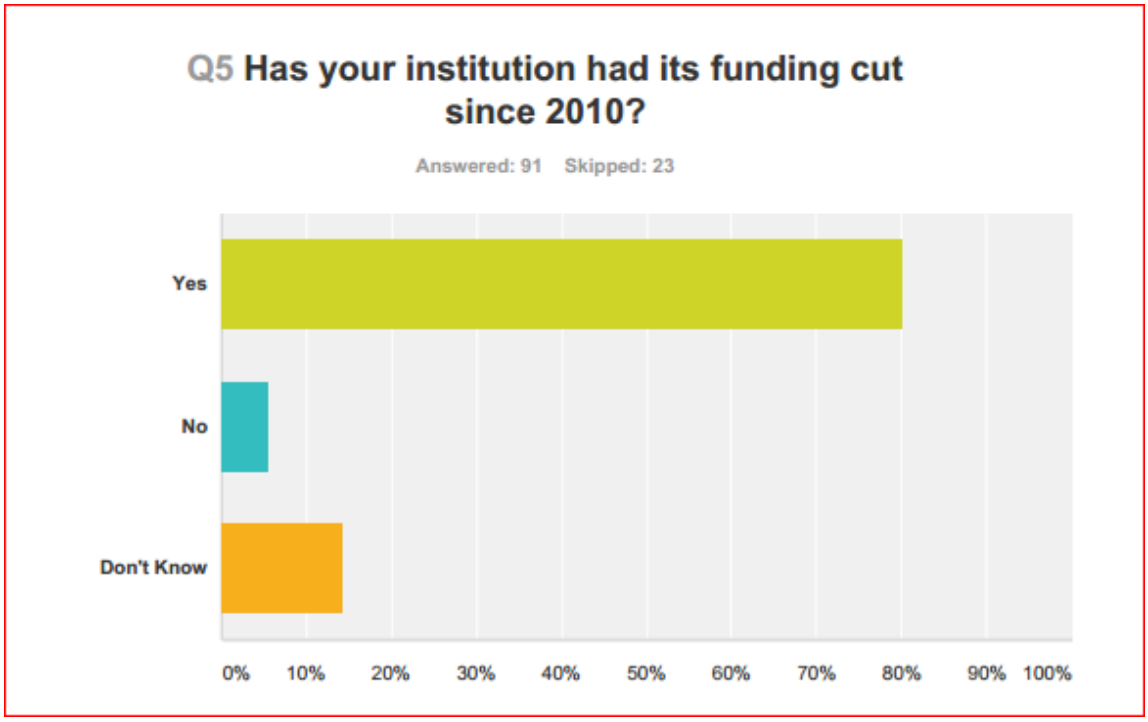


Figure XI.4a Chart indicating responses to having funding cut since 2010.

Of the institutions which stated having had their funding cut, almost 30% (29.2% or twenty-one institutions) stated that they knew by how much, (with some giving the amounts in either pound sterling or percentage of total budget) with the remaining 70.8% (fifty-one institutions) stating that they did not. Reported cuts in funding varied in amounts from up to £4 million to as much as 100% of budget and included a reduction in staff numbers by thirty-four for one particular institution.

Even participants who replied *don't know* to having had their funding cut, 40% (or six institutions) admitted that their roles had in fact been affected, albeit in a relatively minor way. Those effects overlap with institutions whose funding was cut and include not being able to hire staff as needed and a limit put on pay increases. One participant who replied to receiving the same amount of funding as previous years,

also stated that there were now “considerable emphasis on innovation needed to achieve a move to low carbon, low emissions campus”, indicating more pressure to reduce their carbon footprint. In order to determine the extent to which departments/teams were affected, participants were given a list of possible responses.

Those responses included:

•A reduction in number of staff in department/ team (39 survey participants);

•A reduction in number of job related resources (membership of support organisations, other university resources (13 survey participants);

•An inability to purchase sustainable equipment (11 survey participants) or participate in sustainable projects (5 survey participants); and

•A freeze/reduction in funding available to attend conferences, workshops, events (21 survey participants);

•A freeze/reduction in funding available to attend continuous professional development (CPD) course, evening classes (12 survey participants);

•An inability to complete in full and already established sustainable projects (7 survey participants);

•A loss of financial savings made as cost saving exercises have been scrapped (4 survey participants);

•An increase in workload (31 survey participants);

•An increase in overall work-related stress (22 survey participants);

None of the survey participants reported a decrease in workload despite a total of eight survey participants reporting having to either take a pay cut, reduce their hours or cut their benefits. Even the fourteen survey participants, who answered *No* or *Don’t Know* to having their team or department being directly affected, admitted to still experiencing some effects. However, the 2010 announcement of a £600 million cut in funding to education and research has been seen as an opportunity for some institutions to examine their sustainable performances and to work on areas where there is scope for improvement. At least 71% of institutions have implemented some sort of sustainable initiative since the cuts were announced. Those initiatives included switching off equipment and lights when not in use, investing in energy saving equipment, engaging in behavioural change and the appointment of a green

champion/ to monitor and reduce energy usage and waste created and these data are illustrated in Figure XI.4b. While the overall impact of the 2010 cuts in funding may be negative, some institutions regarded those measures of austerity as opportunities to demonstrate how wasteful their behaviour had been and how best to improve such practices. For others, it has strengthened their push for the use of more sustainable equipment across campus. UK FHE institutions have also indicated a more conscientious and innovative approach to their environmental decision-making since the cuts were announced.

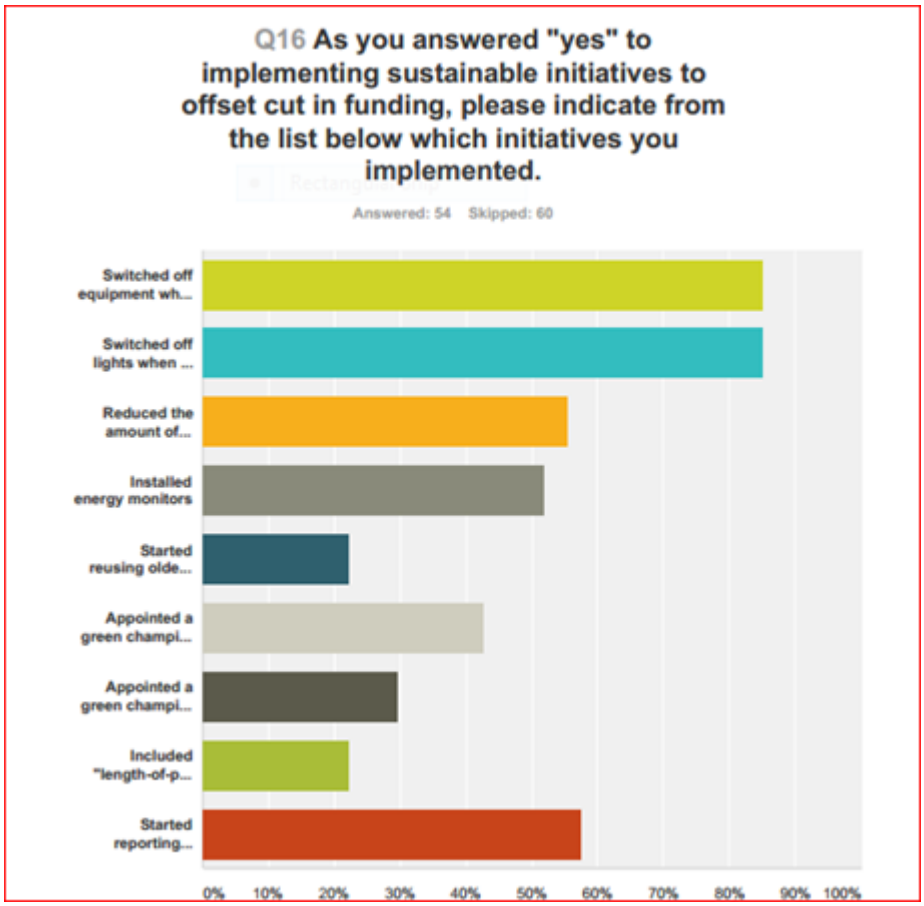


Figure XI.4b Chart indicating initiatives implemented to offset cuts in funding.

Appendix XI.5: Additional Survey.

In October of 2011, a survey was carried out by a researcher at St. John's University in Wales (now part of the University of Wales) to establish which UK HEI or FEI institutions had a green ICT or sustainability policy in place and what their reasons for doing so were. Results of the survey indicated that 68% of institutions had a green ICT or sustainability policy while the remaining 32% did not. Of the institutions that stated they had a green ICT policy, they indicated an improvement of green

credentials (23.8%) as being the main driver for creating such a policy, followed by carbon reduction (19%) and social reputation as being in joint second place (19%). Cost savings was in third place (14.3%), but ironically cost-cutting due to the economic downturn was not cited as being a reason for any of the institutions implementing a green ICT policy. Respondents also indicated improvement of efficiency (9.5%), political pressure (9.5%) and legislation (4.8%) as being reasons for implementing such a policy. However, regardless of institutions having a green ICT policy or not, results of the survey indicated that the use sustainable ICT equipment was prevalent. Table XI.5 indicating the categories of sustainable ICT and their UK FHE percentage use.

Table XI.5 Percentage Use of Sustainable ICT Equipment.

Green ICT Initiative	% Use by UK FHE's
Server Virtualization	88.9%
Multi Functional Printing Devices	74.1%
Active Power Management	48.1%
Server Power Management	33.3%
Virtual Desktops	33.3%
Thin Clients	48.1%
Renewable Power	7.4%
Green Disposal Policy	66.7%
Flexible Working Policy	44.4%

Discussion and Conclusions.

Almost 20% of institutions stated being recognised for their green ICT initiatives, and 53% of institutions employed staff who were dedicated to environmental impacts and performance. These results are not unlike the results of the The Procurement for Green ICT Survey. Results of that survey indicated that ICT managers showed

a strong concern for the environment and a willingness to participate in environmental matters. Results also indicated there was a good overall ICT presence in environmental/sustainable committees with a strong indication that environmental issues were a concern for ICT managers. However, results also indicated scope for improvement, as many ICT managers were unaware of key sustainable ICT issues such as e-Waste, the use of whole life costing tools when procuring for ICT equipment and disposing of ICT equipment packaging. This was a real concern for institutions wishing to reach their carbon targets and indeed for the overall sector. Inhibiting the establishment of carbon emissions and the monitoring and improving of them will prove even more difficult if almost half of institutions do not have a staff member accounting for environmental performance (Hogan, 2011b). Results of this survey also indicated that ICT managers showed a strong concern for the environment and a willingness to participate in environmental matters. Results also indicated a good overall presence of ICT managers in environmental/sustainable committees with a strong indication that environmental issues are a concern for ICT managers. Results also indicated scope for improvement, as many ICT managers were unaware of key sustainable ICT issues such as e-Waste, the use of whole-life costing tools when procuring for ICT equipment and disposing of ICT equipment packaging (Hogan, 2011b).

To summarise, if ICT/IT managers are not involved in procuring for greener technologies at their institutions it appears to be due to poor stakeholder engagement and lacking managers especial with senior managers in mind.

In total four surveys were carried out whose collective results indicated a series of barriers to institution participating in sustainable ICT projects. Those barriers included cuts in funding, restrictions from budget-holders and decision-makers and managers lacking in a series of resources crucial to the efficient running of an institution.

Appendix XII: Chapter 5 Part (I): Full Data Analysis of Results. The UK and Irish Surveys: A Quantitative Study.

Introduction.

As with the main findings in chapter 5 this appendix reports on the results of the conceptual framework surveys that were circulated via e-mail to over 215 UK and Irish FHE sector managers in November of 2014. The UK survey was circulated to the 146 subscribers to the EAUC-London JISCMail mailing list. While the identity of subscribers to this mailing list is confidential, it is likely to have included any remaining SUSTE-TECH and Scotland project participants who were also likely to be subscribers of the EAUC's Green ICT communities of practice mailing list. Respondents to the Irish survey were members of An Taisce's ICT mailing list and comprised of sixty-nine Irish FHE managers. In total 215 UK and Irish FHE managers received their respective surveys resulting in a 41% (60/146) response rate in the UK survey and a 23% (16/69) response rate in the Irish survey. These response rates averaged out at 35% (76/215) and analysis of each of the questions responses are included.

The surveys were designed to further investigate and validate the seven possible barriers to universities and colleges participating in sustainable ICT projects, by projecting further investigation within the UK and Irish FHE sector. There were a total of nineteen questions, with seven of them pertaining directly to each of the possible barriers. Each question had a choice of answer options and while most of the answer options were closed answers, some were open in the form of comment boxes.

The questions pertaining to the barriers included:

1. When implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged? i.e. were they willing to adjust to changes in job roles, train in the use of greener technologies etc.?

2. Is participating in green ICT projects typical of your institution's culture?

3.Of the government organisations listed (HEFCE, DEFRA, DECC, Salix, Local Authorities, Other Government Funded Organisation) please state how they have affected your institution's participation in green ICT projects (Excellent Driver to Very Poor Driver).

4. Do you feel that green technology delivers on the financial and carbon savings promised by IT companies?

5. Have recent cuts in funding to the educational sector affected your institution's ability to participate in sustainable ICT projects?

6. Assuming your institution is part of a framework (e.g. LUPC) that includes criteria for the purchase of sustainable technology, do you feel you are supported in your choices to purchase more sustainable technology?

7. Do you feel your institution's ICT manager(s) are "lacking" by exhibiting any of the characteristics below?

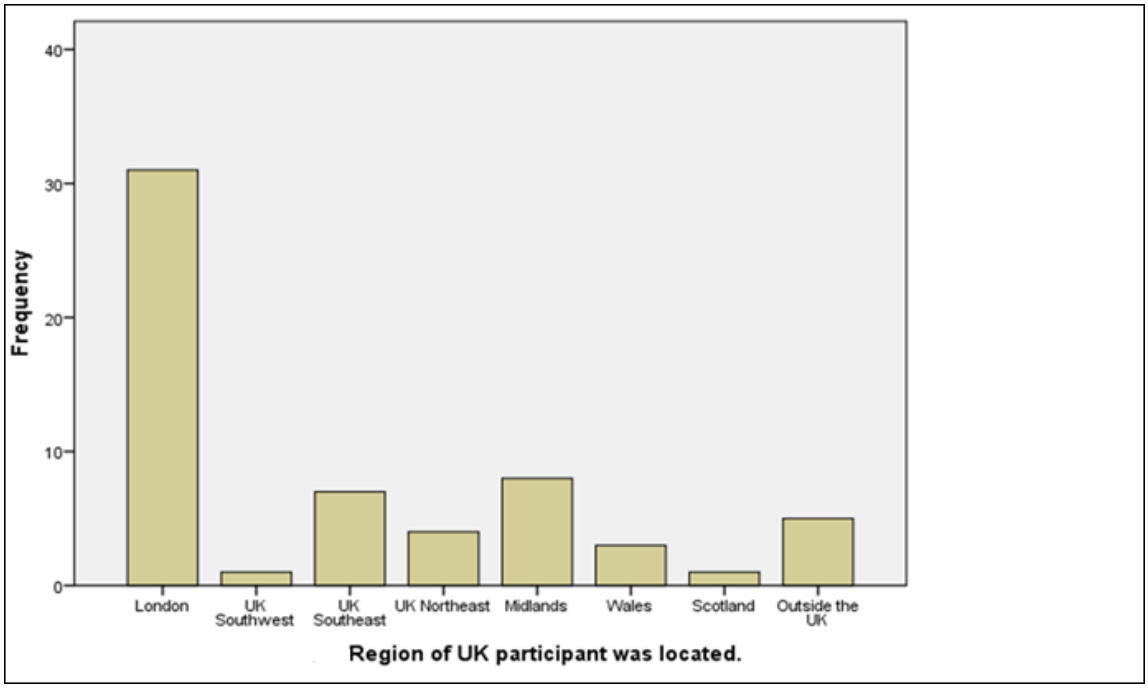
Six of the seven questions offered a "Yes, No or Somewhat" response option to them with follow-up answer options asking why respondents might have chosen that answer. The surveys were conducted via e-mail as opposed to face-to-face interviews or via telephone, as it was thought to be the most practical and efficient method of engaging with such a large number of FHE managers within a reasonable time-frame. The surveys were created using the online survey support website SurveyMonkey. SurveyMonkey offered an easy-to-use tool for creating surveys that allowed for multiple choice answers and follow-on questions. All survey results were automatically tabled and graphed, making their analyses easy to read. Further analysis could be conducted on a participant-by-participant basis, allowing the researcher to gain a better insight into the overall mindset of an FHE manager. Most importantly, the UK and Irish surveys were conducted to gather quantitative data on each of the seven possible barriers, as the researcher was concerned with gaining objective knowledge on the subject and wanted to use an established and scientific method of enquiry. Results of the surveys would essentially validate, or invalidate, the theory that each of the seven barriers existed and answer the research questions. The nineteen questions in each of the surveys received the following responses.

Regional Location of UK Institutions.

The UK survey commenced by asking each of the respondents the location of their institution within the UK. The locations were divided up into 9 regions including Wales and Scotland and outside of the UK. The frequency for each UK region are shown in Table XII.1

Table XII.1: Regional Location of Respective Institutions.

	Frequency	Valid Percent
London	31	51.7
UK Southwest	1	1.7
UK Southeast	7	11.7
UK Northeast	4	6.7
UK Northwest	0	0
Midlands	8	13.3
Wales	3	5.0
Scotland	1	1.7
Outside the UK	5	8.3
Total	60	100.0



Analysis of Responses.

More than half (51.67%) of respondents were from the London area with all other regions except the UK Northwest being represented. This may be due to the researcher being an active member of the London University Environmental Group (LUEG). The researcher regularly attended meetings, was chair-buddy of two of its subgroups, the Space Management and Education for Sustainable Development (ESD) subgroup and regularly contributed to its discussion forum. It may also be because there is a higher concentration of FHE institutions in the London region than anywhere else in the UK (HESA, 2016). Representation from the six others regions UK South East, UK South West, UK North East and the Midlands may be due to the managers familiarity with researcher since, managing the UK SUSTE-TECH and Scottish Sustainable ICT projects. When the UK survey was circulated, three managers from Irish institutions took part, who are each likely to have been subscribers to the EAUC Green ICT communities of practice mailing list. The researcher decided to allow their responses to remain part of the UK survey as the research focuses on in situation in the UK and Ireland. Also analysis of the results of the UK survey was completed before the decision was made to create a separate Irish survey and SurveyMonkey does not facilitate the transference of responses from one survey to another, graphs and tables would have been inconsistent with analysis of data. In addition, three surveys that were categorised as being outside of the UK, were also included in the overall UK survey analysis. This is because their

responses contained useful UK FHE based information. The researcher decided that while they were completed by participants who were residing outside of the UK at the time of completing the survey, they were in fact responding to the survey questions based on their UK experience as FHE managers. None of the responses from the five outside of the UK surveys affected the overall outcomes of the research significantly, but instead contributed to them. Overall the number of respondents was representative of the general population of FHE managers in the UK whose remit included ICT or environmental or sustainability roles. These results indicate a representative sample of management's experience of barriers when implementing sustainable ICT projects. A response rate of 43% lies within the statistical spectrum of the bell curve of reliability, so results are reliable and valid.

Job Title of Respondents.

This question was asked in order to clarify what type of managers were participating in the UK survey. Survey respondents were asked to indicate from a selection of nine options their role within their institution.

The job titles of respondents are summarised in Table XII.2

Table XII.2: Job Titles of Respondent to UK Survey.

Job Title	Frequency	Valid Percent
ICT/IT Manager	11	18.3
Environmental/Sustainable Manager	15	25.0
Energy Manager	3	5.0
Estates and Facilities Manager	2	3.3
Procurement/Finance Manager	2	3.3
Utilities Manager	1	1.7
Other	26	43.3
Total	60	100.0

Discussions and Evaluation of Responses.

All sixty survey respondents answered this question with 43.33%, or twenty-six choosing the *Other* option. The remainder of replies, 25%, or fifteen respondents, predominantly came from Environmental or Sustainable Managers with just over 18% or eleven replies coming from ICT/IT managers. 5% or three responses came from Energy managers and just over 3% of replies came from Estates and Facilities and Procurement managers. Neither Space Managers nor Carbon Managers participated in the survey. Twenty respondents left a comment, two stated they were librarians, seven stated they were an ICT/IT managers of sorts and four indicated their roles had an environmentally sustainable aspect to them. Respondents who categorised themselves as “Other” managers included a departmental manager, a project and programme manager, a lecturer and a member of the administrative staff. Even though the majority of responses were from Other managers, on closer examination of the comments, those who categorised themselves as “Other” managers included two senior lecturers (one of sustainable design and manufacture), a data centre manager and team leader, a library assistant, a data centre designer, two students (one a PhD student of the environment), a project manager, two library assistants (one senior), four ICT/IT managers of sorts (computing services, a technology adviser, a senior IT support officer and senior IT engineer) a consultant, a departmental manager and a programme manager, staff from administration and events, a corporate project manager and an administration officer. Responses from “Other” managers could have been re-categorised under the ICT or IT managers category where appropriate thereby increasing the number of respondents from eleven (18.3%) to eighteen (30%). However, the researcher choose not to re-categorise the original data as it would have undermined the authenticity of how some managers view themselves and their roles within their institution. If a manager who works as a senior IT support office does not consider his or her role to fall under the description of “ICT/IT manager of any kind”, but instead belongs in the “Other” category, then this needs to be acknowledged within the scope of this research. Space management is sometimes the responsibility of those in administrative roles and departmental managers typically manage their

allocated space across campus as do environmental/sustainable managers too. Results therefore suggest that while some categories of FHE managers appear to be under-represented, they have in fact participated. Results also gave an indication of the broad spectrum of responsibility and variation of job roles that includes aspects of environmental sustainability. The responses to the questions were as follows.

XII.3 Length of Time in Current Role.

UK Respondents were then asked about the duration of time in their current role. Respondents were asked to choose from a selection of six options that give the number of years in their role at their current institution. Answer options were divided into increments of 5 years starting at zero and ending at thirty. The number of years respondents were in their current role are summarised in Table XII.3.

Table XII.3: Number of Years Respondents were in Current Role.

Number of Years	Frequency	Valid Percent
0-5 years	33	55.0
6-10 years	15	25.0
11-15 years	4	6.7
16-20 years	4	6.7
21-25 years	2	3.3
26-30 years	2	3.3
Total	60	100.0

Analysis of Responses.

All sixty survey respondents replied to this question with the majority 55%, or 33 respondents working in the sector less than five years. This was followed by 25% or fifteen respondents having worked in the sector between six and ten years and just under 7% or four respondents having worked in their roles between eleven and fifteen and sixteen and twenty years respectively. Finally, just over 3% or two

respondents indicated working in their roles between twenty-one and twenty-five and twenty-six to thirty years, respectively. The fact that the majority of respondents were in the role for five years or less indicated two things:

1. An indication of FHE managers having limited experience and therefore possibly having less knowledge when identifying and attempting to overcome barriers. Being in a role less than five years may bring with it an overly optimistic approach to implementation of sustainable initiatives with an inability to foresee possible hurdles. Inexperienced staff may have less knowledge of how their university operates or which channels are best to go through to ensure a project's success.

2. Contrary to this evaluation, being in a role for five years or less might indicate a manager who is younger and is therefore likelier to have more energy to persevere when faced with barriers. It is also likelier they are aware of the latest technology that supports the efficient management of a campus, therefore facilitating greater productivity. Being in a role for five years or less might indicate a workforce that is not experiencing job burn-out or ambivalence as often happens when working in the same role for longer periods of time. This question was asked to gain insight into the level of experience respondents had in relation to implementing sustainable ICT initiatives and would give authenticity to answers. If results indicated that staff were in their roles for a considerable number of years, their input would be likelier to be more reliable and realistic. However, as replies indicated the majority of respondents were in their role five years or less, with the number of managers in their role decreasing as the category of years increased, this indicated a younger and possibly less experienced group of managers. Nonetheless, managers being in their role for five years or less does not necessarily indicate an inability to identify and overcome barriers when implementing sustainable ICT initiatives (Garthwaite, 2017; Folkman, 2015). If results had indicated that staff were in their roles for a considerable number of years, responses to the remaining sixteen questions could be considered more credible. Alternatively, older managers might be experiencing career burnout and their responses might be biased against anyone attempting to implement change.

XII.4 Number of Years Worked in the University and College sector.

This question allowed respondents to offer information and knowledge that they may have on their total experience working in FHE sector. It also allowed for the comparison of responses from respondents who may have changed jobs during their careers and how valuable their input might be.

The number of years respondents worked in the university and college sector are summarised in Table XII.4.

Table XII.4: Number of Years in the UK University and College sector.

Number of Years	Frequency	Valid Percent
0-5 years	20	33.3
6-10 years	14	23.3
11-15 years	13	21.7
16-20 years	4	6.7
21-25 years	5	8.3
26-30 years	4	6.7
Total	60	100.0

Analysis of Responses.

All sixty respondents answered this question. Results indicated that as long as they had been working, they remained within the FHE sector. Results were similar to that of the previous question with the majority of respondents, 33%, having worked in the sector for five years or less, almost 24% or fourteen stating they had worked between six and ten years and just less than 22% or thirteen respondents stating they had worked in the sector between eleven and fifteen years. Just under 7% stated they had worked between sixteen and twenty years with slightly more, over 8%, or five respondents stating they had worked between twenty-one and twenty-five years. Finally just four survey respondents or less than 7% stated they had worked between twenty-six and thirty years.

The fact that the majority were in the sector less than five years indicates a younger workforce that typically brings with it energy and idealism and knowledge of the latest in sustainability and ICT (Garthwaite, 2017; Folkman, 2015). However, as the minority of survey respondents had been in the FHE sector almost thirty years, they are likely to bring to the survey a wealth of experience. They are likely to have faced one or more of the barriers at some point in their careers and possibly in other roles within the FHE sector. It might also be that after more than twenty years of working in the FHE sector they consider all minor issues to be barriers and are far less likely to participate in anything new as they have “seen it all before”. They may have become despondent and ambivalent in their roles and might be reluctant to engage with or are suspicious of change. This in itself may be perceived as a barrier.

Summary of UK Survey Respondents Background.

Response indicated that the majority of managers who took part in the survey were from London institutions with the remainder of the UK represented in varying amounts. Those managers were predominantly ICT/IT managers, environmental and sustainability managers and Other managers. The majority of managers were in their roles five years or less and had worked in the FHE sector during that time with the remainder having worked in the sector up to 30 years. Establishing background information on the respondents added not only credibility and value in identifying the seven barriers, it allowed the researcher to compare and contrast responses based on those backgrounds. The follow-on fifteen questions were specific to each of the seven barriers and aimed at gathering critical information and data on each barrier.

Table XII.5 Stakeholder Engagement.

The fifth question related to stakeholder engagement and offered three answer choices.

The question asked “when implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged, i.e. willing to adjust to changes in job roles, train in the use of greener technologies etc.? Whether respondents were engaged or not are summarised in Table XII.5.

Table XII.5: Stakeholder Engagement

Engage or Disengaged.	Frequency	Valid Percent
Yes	18	36.7
No	6	12.2
Neither engaged nor disengaged	25	51.0
Total	49	100.0

Analysis of Responses to Stakeholder Engagement.

Replies were mixed with only forty-nine respondents choosing to answer this question and eleven omitting it. Almost 37% (18) of respondents stated that stakeholders were engaged and just over 12% (6) stated they were not engaged with more than half, 51.02% (25) stating that stakeholders at their institution were neither engaged nor disengaged. There was no option to leave a comment in this question. Of the 49 managers who answered this question, none stated they had not tried to implement greener ICT in their institutions. Overall results indicated the majority of respondents 87.75% (43) were engaged on some level answering either “Engaged” or “Neither Engaged nor Disengaged” in implementing greener ICT initiatives in their institution. Just over 12% stated they were not engaged indicating a clear breakdown in communication and understanding of the benefits of more sustainable technology.

To further investigate the reasons for engagement or lack thereof, respondents were asked to choose from a series answer options as to why they responded the way they did. A summary of their response for choosing their answer options are summarised below.

XII.6: *Yes* Responses to Stakeholder Engagement.

As you answered *Yes* to the Stakeholder Engagement question, please choose from the answer options below that best describe why you answered *Yes*. See Table XII.6 for a breakdown of the results.

Table XII.6 Reasons for "Yes to Stakeholder Engagement" answers.

Reasons for *Yes* Responses to Stakeholder Engagement	Frequency	Valid Percent
Stakeholders were informed and included in the decision-making process.	12	37.5
Older technologies were starting to slow down/fail, newer, faster technologies were welcomed.	9	28.1
Stakeholders welcomed initiatives that reduced energy bills and carbon emissions.	11	34.4
Total	**32**	**100.0**

Analysis of *Yes* Responses to Stakeholder Engagement.

To explore further, respondents who answered *Yes* to Stakeholder Engagement were then asked to choose from answer options that best described why they answered *Yes*. Reponses indicated it was because stakeholders were informed of the decision and felt included in the decision-making process. This was closely followed by older technologies starting to slow down/fail, and newer, faster technologies being welcomed into the workplace. Stakeholders also welcomed initiatives that reduced energy bills and carbon emissions. Respondents could choose more than one answer option and each of them did, indicating there is no preferred or more appropriate singular method of engaging with stakeholders when switching to the use of more sustainable technologies.

***No* Responses to Stakeholder Engagement.**

Those who answered *No* to Stakeholder Engagement were asked to choose from the answer options below as to why they thought stakeholders at their institutions were not supportive of the switch to greener ICT. Respondents were given four answer options but only two of those options were chosen. Results are summarised in the Table XII.7.

Table XII.7: Reasons for "*No* to Stakeholder Engagement" answers.

No responses to Stakeholder Engagement"	Frequency	Valid Percent
Switching to greener ICT resulted in disruption to services	0	0
Stakeholders not liking to adjusting to green ICT initiatives such as printing and copying double sided, communicating electronically instead of using paper etc.	0	0
Switching to greener ICT required behavioural change such as Printing and Copying double sided or eliminating paper use where possible, communicating using technology as oppose to travelling long distances, sharing user services as opposed to exclusive ownership of technologies and equipment etc.	2	40.0
Stakeholders expressed their lack of confidence in "green ICT" i.e. new technology is not very green.	3	60.0
Total	5	100.0

Analysis of Responses No to Stakeholder Engagement.

Of the respondents who replied *No* to Stakeholder Engagement, none of them indicated that it was either because of switching to Greener ICT resulted in a disruption to services or it was because stakeholders did not like having to adjust to greener initiatives. However, 40% (2) replied that switching to greener ICT required behavioural change such as printing and copying double-sided and this was proving to be the barrier. 60% (3) replied that stakeholders had expressed their lack of confidence in greener ICT and new technology was not very green. Answer options two and three to this question were very similar except for the distinction of the inclusion of the term behavioural change in answer option three. Reference to this appears to have resonated with respondents and they may associate behavioural change with being a source of frustration. Results also indicated that for respondents who answered *No* to stakeholder engagement, there was less of a disinterest in

being sustainable or thinking that implementing green ICT is disruptive, and more that behavioural change required effort that does not necessarily result in cost or carbon savings.

XII.8 Neither Engaged nor Disengaged Responses to Stakeholder Engagement.

Survey respondents were asked to choose from the answers below that best described why they answered “neither engaged nor disengaged”. There were only two answer options to this questions and respondents could give both answers. Twenty-four managers answered both questions and replies indicated that engagement/disengagement of stakeholders was due to their not having an opinion on the switch to greener technologies, partially due to their not being informed of the switch. Results are summarised in Table XII.8 below.

Table XII.8: Reasons for *Neither Engaged nor Disengaged* Responses to Stakeholder Engagement.

Reasons for *Neither Engaged nor Disengaged* Responses to Stakeholder Engagement	**Frequency**	**Valid Percent**
Stakeholders were not informed of changes to green ICT, they happened gradually over the course of the year.	10	41.7
Stakeholders didn't have an opinion on the switch to greener ICT, some protested, some supported, most said nothing.	14	58.3

Total	24	100.0

Analysis of Responses to Neither Engaged nor Disengaged. Respondents were given a choice of two answer options. More than 40% stated that stakeholders were not informed of the changes to greener ICT, they happened gradually over the course of the year(s) and almost 58% (14) stated that their stakeholders did not really have an opinion on the switch to greener technology, some protested, some were vocal supporters, but most said nothing. This ambivalence towards the implementation of greener ICT was due to staff not being informed of the changes to the use of greener technologies. However, providing there is a gradual and minimal disruption to services, there will be minimal protest. For others, they simply did not have an opinion on sustainable technology.

Summary of Responses to Stakeholder Engagement.

The responses of questions relating to stakeholder engagement indicated an overall trend towards the positive uptake of greener technologies with the majority of staff being either positive or ambivalent toward greener ICT and happy to participate in, or at least not inhibit, its implementation. Therefore, engaging with stakeholders *might not be* considered a significant barrier to participation in sustainable ICT projects.

It's worth noting however, that full engagement was due to stakeholders being included in the decision-making process, closely followed by the slow-down or failure of existing technologies and newer faster technologies replacing them. Stakeholders also support any initiative that helps reduced energy bills and carbon emissions, indicating that the use of sustainable technology to improve environmental performance captured the hearts and minds of some FHE employees. Being neither engaged nor disengaged was only as a result of being uninformed of implementation of greener technologies, that had happened gradually over the course of the year(s) and / or because staff did not have an opinion either way. Neither of these reasons would be considered a barrier, as such. However, stakeholder engagement can be considered a barrier in some institutions as results indicated that the environmental and financial benefits of using green ICT is not believed in by everyone. Stakeholders are reluctant to start utilising greener technologies when they are required to deviate from what is familiar.

XXII.9 Culture of Green ICT.

Survey respondents were asked if participating in green ICT projects was typical of their institutions' culture. This was to establish if it was proving to be a barrier to participation in sustainable ICT projects.

Results.

Respondents were asked to choose from three answers options and the results of this question are summarised in the Table XII.9.

Table XII.9: Culture of Green ICT in UK Institutions.

Responses to Culture of Green ICT in UK Institutions	Frequency	Valid Percent
Yes	21	51.2
No	11	26.8
Neither typical or non typical.	9	22.0
Total	41	100.0

XII.9 Analysis of Responses to Culture of Green ICT.

Forty-one respondents answered this questions with more than half 51.22%(21) of respondents stating it was part of their institutions culture and almost 27%(11) stating it was not. The remainder, 22% (9) stated that it was neither typical nor non typical. These results show that green ICT projects are typical of the majority of institutions' culture, indicating a capture of the hearts and minds of stakeholders in favour of sustainable initiatives. However, for some institutions green ICT is not part of their culture and for others it neither is nor is not.

XII.10 Yes Responses to Culture of Green ICT.

Of those that answered Yes to green ICT being part of their institutions culture, survey respondents were then asked why they answered *Yes* and given two answer options. Responses to that question are summarised in the Table XII.10

Table XII.10: Reason for Green ICT Culture in UK Institutions.

Reason for Green ICT Culture in UK Institutions	Frequency	Valid Percent
Proactive and innovative senior manager	18	85.7
Our institution is a leader in ICT research so participation in such projects is typical.	3	14.3
Total	21	100.0

Analysis of Yes Responses to Culture of Green ICT in UK Institutions.

Respondents were then asked to explain why they answered *Yes* to Green ICT being part of their institutions' culture. 100% of respondents who answered Yes stated it was due to having a very innovative and proactive senior manager(s) who encouraged participation in sustainable projects, green ICT or otherwise. Almost 15% (3) of respondents stated that "their institution was a leader in ICT research with strong links to other research organisations". The results clearly indicate that when managers are adequately resourced, are passionate about their roles and who engage with staff and students, they contribute significantly to the successful outcomes of a green ICT project and are instrumental in overcoming barriers. Comments supported this engagement of hearts and minds as four of the comments included a reference that a switch to greener ICT was in an attempt to reduce their institutions' carbon footprint. However, some of the comments were not as supportive. One respondent stated that it was as an unintended result of the switch to newer technology where their previous equipment had been underperforming. Another comment stated that that switching to greener technology was driven by the "student experience" expecting ICT to consistently work where their students were not concerned about their energy implications. Regardless of the reasons for the switch to greener technologies, it was clear that the culture of engaging with technology to make a campus more sustainable is crucial to overall environmental

performance and counteractively, having a culture that is not supportive will inevitably prove to be a barrier and a limiting factor.

No Responses to Culture of Green ICT.

Of those who answered *No* to green ICT being part of their institutions' culture, survey respondents were then asked why they answered *No* and given a choice of two possible answer options. Answer options included institutions senior manager(s) not being interested in participating in sustainable projects, green ICT or otherwise or institutions being very traditional in the subjects taught and rarely deviating from them. Responses to that question are summarised in the Table XII.16.

Table XII.11: Reasons for Absence of Green ICT Culture in UK Institutions.

Reasons for Absence of Green ICT Culture in UK Institutions.	Frequency	Valid Percent
Senior management not interested in green ICT projects.	8	72.7
Traditional in the subjects it teaches and rarely deviates from them.	3	27.3
Total	11	100.0

Analysis of No Responses to Culture of Green ICT.

Participating in green ICT projects was clearly not part of every institution's culture. So the aim of this question was to establish why that was the case. Of the 10 survey respondents who answered *No*, almost 73% (8) stated it was due to their institution's senior manager(s) lack of interest in participating in sustainable projects, green ICT or otherwise. This indicated that lacking managers is a main barrier to participation in greener ICT projects. An additional 27.3% (3) stated their institution was very traditional and not very innovative or proactive when it came to participating in new projects. Respondents left comments referring to green ICT not producing savings, switching to green ICT interfering with productivity. Others commented that while their institution was engaged with sustainable initiatives, ICT was not part of their

institution's overall sustainable projects. This indicated that for the most part, employees are not overly concerned with the workings of the university so long as it does not severely impact their ability to work. Respondents also stated that they do not always have "buy in" from senior managers, indicating the importance of support from senior management to the success of projects, green ICT or otherwise. SC It also proved how detrimental a barrier to ICT projects lacking managers can be. Implementation of sustainable ICT project is something that must be carefully managed with this in mind.

"Typical nor not Typical" Responses to Culture of Green ICT.

No answer options were offered in this question, instead respondents were invited to leave a comment pertaining to why they answered that green ICT was neither typical nor not typical at their institution. A summary of those comments are given in below.

- Some Green ICT projects are adopted, some are not, all depending on availability of staff and the department implementing them. Staff play a key role in the success of a project and without forward thinking energetic staff, green wins cannot be achieved.
- Because, as with most things, it depends on the part of the institution. There are some examples of good practice and lots of examples of bad practice!
- Because the respondents has no idea. We have a new head of IT, and there doesn't seem to be a clear typical anything right now.
- Incorporating sustainability within IT requires collaboration between the Sustainability Team (in the Estates Division), and the IT Division. This means it is sometimes hard to align objectives,but there is general willingness to make progress. The challenges of the institution being siloed, and the enabling factors of people being willing to try to make something work, are both typical of the organisation.
- It happens as an unintended consequence of upgrading to newer equipment.
- It varies across the organisation.
- Not aware of a change to greener ICT.
- Not sure that senior managers fully engage unless you play the cost savings card however proactive lower levels of management are.

- Running IT is not the main business for a University and is largely a technical task so for the bulk of infrastructure work, IT professionals were left to get on with it and users do not engage. Where change impacted users, then there was proper involvement through projects and change management.

Discussions and Evaluation of "Neither Typical nor not Typical" Responses to Culture of Green ICT.

Unsurprisingly, results are mixed with some institutions stating that Green ICT is part of their culture and others indicating it is not. Comments left by those who feel that green ICT is neither typical nor not typical clarifies why this is the case. For most institutions their culture of lacking and/or inactive managers is proving to be a barrier as is proving that green ICT is a cost saver.

XII.12 Government Organisations as Drivers.

Several Government organisations offer assistance with reducing carbon emission but offer different incentives and therefore can act as drivers in different ways. Those organisations are HEFCE, DEFRA, Salix, Local Authorities and Other Government Organisations.Survey respondents were asked to state how each of the organisations had affected their institution's participation in green ICT projects and responses for each organisation are summarised in the Tables XII.12 , XII.13, XII.14, XII.15, XII.16 and XII.17.

Tables XII.12: HEFCE as a driver for as a driver for Green ICT.

HEFCE as a driver for as a driver for Green ICT.	Frequency	Valid Percent
Excellent Driver	6	18.2
Good Driver	13	39.4
Neither Good nor Bad Driver	11	33.3
Poor Driver	3	9.1
Total	33	100.0

Tables XII.13: DEFRA as a driver for as a driver for Green ICT.

DEFRA as a driver for as a driver for Green ICT.	Frequency	Valid Percent
Excellent Driver	1	3.0
Good Driver	5	15.2
Neither Good nor Bad Driver	21	63.6
Poor Driver	5	15.2
Very Poor Driver	1	3.0
Total	33	100.0

Tables XII.14: DECC as a driver for as a driver for Green ICT.

DECC as a driver for as a driver for Green ICT.	Frequency	Valid Percent
Excellent Driver	2	5.9
Good Driver	6	17.6
Neither Good nor Bad Driver	20	58.8
Poor Driver	5	14.7
Very Poor Driver	1	2.9
Total	34	100.0

Tables XII.15: Salix as a driver for as a driver for Green ICT.

Salix as a driver for as a driver for Green ICT.	Frequency	Valid Percent
Excellent Driver	5	15.2
Good Driver	9	27.3
Neither Good nor Bad Driver	15	45.5
Poor Driver	4	12.1
Total	33	100.0

Tables XII.16: Local Authority as a driver for as a driver for Green ICT

Local Authority as a driver for as a driver for Green ICT	Frequency	Valid Percent
Excellent Driver	1	3.2
Good Driver	3	9.7
Neither Good nor Bad Driver	18	58.1
Poor Driver	7	22.6
Very Poor Driver	2	6.5
Total	31	100.0

Tables XII.17: Other Government Funded Organisations as a driver for Green ICT.

Other Government Funded Organisations as a driver for Green ICT.	Frequency	Valid Percent
Excellent Driver	2	6.5
Good Driver	2	6.5
Neither Good nor Bad Driver	23	74.2
Poor Driver	4	12.9
Total	31	100.0

Analysis of Responses to Government Organisation as Drivers.

When questioned about government organisations affecting institutions' participation in green ICT projects, respondents were asked to choose from a selection of answer options: Excellent Driver, Good Driver, Neither a Good Nor a Bad Driver, Poor Driver or Very Poor Driver. Each answer option was to be applied to how they regarded each of the following six government organisations HEFCE, DEFRA, DECC, Salix, their Local Authority and Other Government Funded Research Departments. Just 37 respondents answered this question and replies were mixed with each of the government organisation predominantly being reported as being "neither a good nor a bad driver".

HEFCE, DEFRA, DECC, Salix and the Local Authority scored greater than 33%, almost 64%, almost 59%, 45% and 58% respectively. HEFCE was also considered to be a good driver by almost 40% of survey participants. Other government funded research departments were also regarded by more than 74% (23) of respondents as being neither a good nor a bad driver. HEFCE and Salix were considered by more than 18% (6) and 5% (5) of survey respondents respectively as being excellent drivers. While each of the other government organisations were also considered to be excellent drivers, they were only considered to be excellent drivers in much smaller amounts - between 3% and 7% respectively. Respondents left nine

comments in total that offered a mixture of input ranging from Salix being an excellent driver for Greener ICT to none of the organisations listed being helpful with Green ICT in any way.

Summary of Responses to Government Organisation as Drivers.

It appears as though institutions' experience with government organisations as drivers for implementing greener ICT, varies across the UK. Salix and HEFCE were the focus of at least three positive comments, and negative comments were limited to a few organisations being described as "unhelpful". On closer analysis, some institutions had more than one driver and felt supported by each one, albeit to varying degrees.
Overall, government organisations have proven not to be a barrier but also not much of a driver either. Most institutions are concerned about their overall carbon targets and typically tackle their infrastructure which includes inefficient boilers, clogged pipework, poor insulation, thereby achieving quick wins. ICT energy consumption is not always at the top of an FHE institutions'' list of areas to tackle and there is no additional financial penalty for institutions if ICT related carbon targets are not reached.

XII.18 Green Technology Delivering on Financial and Carbon Savings in UK Institutions.

Respondents were asked "do you feel that green technology delivers on the financial and carbon savings promised by IT companies?", in the hope of establishing if sustainable technology had a reputation within the sector for delivering on cost and carbon savings promised by ICT companies. Preliminary research had shown that in some instances, green ICT demonstrated clear cost and carbon savings but in others, no improvements were made. This question was asked to further inquire why this was the case. Respondents had the option of answering *Yes, No or Somewhat* to the questions and the results of that question are summarised in the Table XII.18.

The majority of respondents replied *Somewhat* to this question, with both yes and no answer replies being answered in the same amount.

Table XII.18: Green Technology Delivering on Financial and Carbon Savings.

Green Technology Delivering on Financial and Carbon Savings	Frequency	Valid Percent
Yes	6	16.2
No	6	16.2
Somewhat	25	67.6
Total	37	100.0

Analysis of Responses to Green Technology Delivering on Financial and Carbon Savings.

Survey respondents were then asked about their belief in green technology delivering on the financial and carbon savings promised by IT companies. Thirty-seven respondents answered this question with a significant majority, amounting to more than 67% (25), stating that they *Somewhat* did. Both *Yes* and *No* replies were answered in equal amounts of 16% (6). Twelve respondents left comments indicating mixed opinions on green ICT and their promise to deliver on cost and carbon savings. The comments provided evidence of various institutional issues such as the lack of collaboration between departments and the trust and distrust of ICT managers regarding the ability of greener technologies to deliver on the cost and carbon savings. This mixture of responses is a reflection of both the positive and negative experiences some managers had when tasked with making cost and carbon savings through the use of greener technology and therefore a clear indication of the reputation of green ICT not always delivering on cost and carbon savings proving to be a possible barrier and limiting factor.

Yes or Somewhat Responses to Green Technology delivering on Financial and Carbon Savings.

Respondents were then asked to explain why they answered either Yes or Somewhat to this question. These replies would highlight the technologies with the better reputation for cost and carbon savings. Respondents had a choice of twenty-three different types of greener ICT initiatives to choose from including: automatic switch off/powerdown of PCs at 5pm/end of work day, Print and Copy double-sided

by default, virtualisation of servers, cloud computing, switching to use of shared services, switching to thin client technology (servers, PCs), switch to BYOD (Bring Your Own Device), the use of video conferencing, the use of greener networks (switches, cables etc.), switching to MFDs (multifunctional devices) for printing, copying, scanning etc., and the introduction of "Hot-Desking" and "Hoteling" (reserving a hot-desk). Respondents were invited to choose from more than one answer option and a total of twenty-nine people answered with ten leaving a comment.

Table XII.19: Green ICT initiatives implemented in UK institutions.

Green ICT initiatives implemented in UK institutions	Frequency	Valid Percent
Automatic switch off/powerdown of PC's when not in use.	18	11.0
Automatic switch off/powerdown of PC's at 5pm/end of work day	8	4.9
Print and Copy double sided by default	21	12.9
Virtualisation of servers	20	12.3
Cloud Computing	16	9.8
Installation of greener data centres	15	9.2
Switch to use of shared services	7	4.3
Switch to Thin Client Technology (servers, PCs)	3	1.8
Switch to BYOD (Bring Your Own Device)	4	2.5
Video Conferencing	15	9.2
Greener networks (switches, cables etc.)	6	3.7
Switch to MFDs (multifunctional devices) for printing, copying, scanning etc.	24	14.7

Introduction of "Hot-Desking" and "Hoteling" (reserving a hot-desk)	6	3.7
Total	163	100.0

Analysis of Yes or Somewhat Responses to Green Technology Delivering on Financial and Carbon Savings.

Combining these sets of results indicated that Green ICT is not a barrier or a limiting factor. Survey respondents indicated that switching to MFDs was by far the most widely implemented green ICT initiative in UK institutions, followed by double sided printing and copying and virtualisation of servers. More than 60% of institutions implemented automatic powerdown of PCs when not in use along with cloud computing. More than half of survey respondents stated they had installed greener data centres. Each of the green ICT initiatives listed were implemented with most of the institutions implementing more than one initiative. This is likely to have been done in an attempt to have a more holistic greener ICT system. In total 168 green ICT answer options were chosen with thin client technology being the most scarcely implemented one. Switching to thin client technology can prove costly as it often requires a significant capital investment so are typically only carried out every five to seven years. This was the only surprising result from this question and may be an indication that it has not delivered on promised reductions of carbon and energy costs. This may have in turn damaged the reputation of green ICT within the sector. It is also possible that institutions were inside of their refresher period and this may be why thin client was so scarcely implemented. With technology advancing as quickly as it has over the past few years, and institutions refreshing their kit and/or implementing a BYOD system, demonstrating clear “before and after” carbon and financial savings is proving increasingly difficult. As institutions downsize, merge and restructure, and as their core business of teaching and research adapts to those changes, analysis of savings is often lost. This inability to do a clear “before and after” comparison (similar to the SUSTE-TECH projects) could be described as barrier or limiting factor of sorts.

No Responses to Green ICT Delivering on Financial and Carbon Savings.

Respondents who answered *No* were then given three answer options to clarify why they answered *No* and could choose more than one answer. Results of those responses are summarised in Table XII.20.

Table XII.20: Reasons for Green ICT initiatives not Implemented in UK institutions.

Reasons for Green ICT initiatives not Implemented in UK institutions	Frequency	Valid Percent
Could not see a reduction in energy costs	2	20.0
Purchase costs far exceeded any savings made	5	50.0
By the time R.O.I was realised, technology was out of date	3	30.0
Total	10	100

(*Valid Percent is calculated in relation to the total frequency of responses to that particular question as oppose to the percentage of total respondents to the question. The total frequency is often higher as respondents choose more than one answer option).

Analysis of *No* Responses Green ICT delivering on Financial and Carbon Savings.

Six respondents replied with just one leaving a comment. The majority of *No* respondents 50% (5) stated that the purchase costs far exceeding any savings made as being the reason they did not purchase Green ICT, followed by 30% (3) of respondents indicating that technology was out of date by the time a return on investment was made. Finally 20% (2) indicated they were unable to see a reduction in energy cost as a result of using greener technologies. The results are quiet even for a direct *Yes* or *No* response indicating that managers have experienced little or no return on investment after implementing greener technologies. This is a clear indication that the reputation of green ICT may be considered a barrier. In addition an overwhelming majority stated that green technology failed to deliver on the financial and carbon savings promised by IT companies. Comments left regarding

this question also indicated a lack of confidence in greener technologies delivering real savings. A few respondents stated that many financial saving were exaggerated and the speed at which technology advances being another issue. One comment included some green initiatives being underplayed, but most responses included many of the green ICT companies making promises based on best case scenarios. None of the respondents stated that green ICT had delivered on substantial savings.

Appendix XII.21 Cuts in Funding.

Survey respondents were also asked if they thought cuts in funding to the educational sector affected their institutions ability to participate in sustainable ICT projects. Responses are summarised in Table XII.21

Table XII.21: Responses to cuts in funding affecting institutions ability to participate in sustainable ICT projects.

Responses to cuts in funding affecting institutions ability to participate in sustainable ICT projects.	Frequency	Valid Percent
Yes	10	27.0
No	17	45.9
Somewhat	10	27.0
Total	37	100.0

Analysis of Responses to Cuts in Funding.

Thirty-seven respondents answered this questions, with twenty-three choosing not to. Almost 46% (17) of survey respondents stated that cuts in funding had not affected their institution's ability to participate in sustainable ICT projects with almost 30% (10) stating that it had, and the same amount, almost 30% (10) stated that it *Somewhat* had.

Two respondents left comments, both stating they did not have information regarding cuts in funding to their institutions and therefore any related effects on

participating in sustainable ICT projects. As the percentage response rate for *Yes* and *Somewhat* answers are the same, this indicates that cuts in funding is a barrier to institutions participating in sustainable ICT projects. Furthermore, when combining both sets of responses, more than half of institutions stated that cuts in funding was a barrier.

If the *Somewhat* answers are considered to be an almost *Yes* answer, this would bring the *Yes* responses up to 40%. However, this is still fewer than the 45% of respondents that answered *No*, indicating it was not a barrier. Contrary to these results a separate survey conducted in 2012 (Hogan, 2012), indicated that institutions were affected by cuts in funding in a variety of ways (see Chapter 4). Results of that survey indicated that seventy-two institutions (80.0% of survey respondents) had had been affected, albeit to varying degrees, since the 2010 cuts in funding were made. Even respondents who replied to not knowing if their funding had been cut or not, admitted that their roles had been affected, albeit relatively minimally. This concludes that cuts in funding *can* be considered a barrier to institutions participating in sustainable ICT projects.

Purchasing Frameworks.

Respondents were then asked if their institution was part of a framework (e.g. LUPC) that included criteria for the purchase of sustainable technology, and did they subsequently feel supported in their choices to purchase more sustainable technology. Responses would identify if procurement departments and those making purchasing decisions were proving to be a barrier or not. The survey also examined the influence of purchasing frameworks as a barrier to participation in sustainable ICT projects. Responses to the question summarised in the Table XII.22

Table XII.22: Membership of Purchasing Framework and Support for Sustainable Technology.

Support in Purchasing Green ICT	Frequency	Valid Percent
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT.	15	42.9

Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT.	8	22.9
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT.	2	5.7
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT.	0	0
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	4	11.4
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	6	17.1
Total	35	100.0

Analysis of Responses to Question on Purchasing Frameworks.

Almost 43% (15) of survey participants stated that they felt supported in their decisions to purchase green ICT because they were part of a purchasing framework, indicating that procurement was not always a barrier and this aspect of stakeholder engagement exists within their institution. Almost 23% (8) stated that while they were part of a framework, they did not feel supported in their decisions to purchase greener ICT, indicating a barrier. More than 17% (6) were unsure if their organisation was part of a framework or not and stated that they did not feel supported in their decision to purchase green ICT.

This is a clear indication of a barrier when trying to implement greener technologies. However, more than 11% (4) stated that they were unsure if they were part of a framework but still felt supported in their decision to purchase greener ICT. This is an indication of how management in some institutions have incorporated sustainability into their purchasing operations and/or some purchasing managers are forward-thinking when it comes to cost savings. None of the respondents stated they were not part of a purchasing framework and did not feel supported in their decision to purchase greener ICT, indicating that each manager who participated in the survey is somewhat aware of being part of a framework but is not necessarily

making the best use of it. 11.4% (4) stated they felt supported in their decision to purchase greener ICT, despite not being sure if they were part of a framework or not, indicating a positive move towards the use of greener technologies. Finally more than 17% (6) stated that they were unsure if they were part of a framework or not, and did not feel supported in their decision to purchase greener ICT, indicating a possible barrier. While the results were mixed, it is clear that the majority of institutions have a framework of sorts in place that supports staff wishing to purchase more sustainable technologies. However, combining the results of those who indicated not feeling supported, comes to 40% which is 20% less than those who indicated feeling supported. Each of the “support poor” respondents were either (i) not part of a framework, (ii) unsure if they were part of a framework or (iii) were part for a framework yet still did not feel supported when purchasing green ICT. Nobody who was not part of a framework stated that they also felt supported, indicating that having a framework in place is crucial to purchasing greener ICT and that not having one may be considered a barrier to participation in a sustainable ICT project.

Appendix XII.23 Lacking Managers.

Survey respondents were asked about the performance of their ICT managers and if they felt their managers were “lacking" by exhibiting any of a series of seven characteristics. It was hoped that responses to this question would identify if underperforming ICT managers were responsible for poor participation in sustainable ICT projects.

Responses to that question are summarised in Table XII.23.

Table XII.23: Characteristics of Lacking Managers

Characteristics of Lacking Managers	Frequency	Valid Percent
Poor knowledge of green ICT issues	10	12.0
Disinterest in green ICT initiatives	12	14.5
Disinterest in "outside" green ICT projects (i.e. participating not requested from senior management)	7	8.4

Is negatively influenced by institutional politics	11	13.3
Is under-resourced in terms of funding for new technology	10	12.0
Is under resourced in terms of allocation of support staff	11	13.3
Is under resourced in terms of allowances for staff training, upskilling, etc.	10	12.0
None of the above	12	14.5
Total	83	100.0

Analysis of Responses to Lacking Managers.

Almost 35% of survey respondents stated that their ICT managers were lacking as they either had poor knowledge of or a disinterest in green ICT projects, “outside or otherwise”. More than 37% stated that their manager was under-resourced in terms of allocation of support staff, funding for new technology or for allowances for staff training with 13% (11) stating that their ICT manager was negatively influenced by institutional politics.

In conclusion, there are a mixture of reasons why ICT/IT managers are unable to participate in green ICT projects. However, there are also several institutions that have ICT managers who are not lacking in any of the characteristics given. This indicates that FHE ICT managers’ ability to do their job effectively varies, and what may be considered a significant barrier in one institution, may not exist in another.

Overall Summary of UK Survey.

Results indicate that barriers to participation in sustainable ICT projects undoubtedly exist in FHE institutions across the UK and those barriers exist in varying amounts as evidenced by the quantitative and qualitative data included in the UK survey. Results also indicate that there are a variety of reasons for the presence or absence of each of those barriers. While many are outside of the control of day to day

managers, they can each be readily overcome via simple but effective changes. Those changes include a renewed approach to environmental sustainability by senior management and effective communication on the benefits of the use of more sustainable technology to all staff. However, there was just as much evidence to suggest that the barriers *do not* exist. Equally as many survey participants replied to not experiencing barriers when asked.
For example, eighteen respondents indicated stakeholders at their institutions' were engaged in sustainable ICT projects versus six stating they were not engaged; twenty-one respondents indicated a culture of green ICT existed at their institution versus eleven stating that it did not; government organisation were considered excellent and very good drivers almost as much as they were considered to be poor or very poor drivers; equal amounts of respondents believed green technology delivered in cost and carbon saving as did not believe; and seventeen respondents thought that cuts in funding had not affected their institutions' ability to participate in sustainable ICT projects as oppose to ten who thought that it had. Finally twenty–one respondents indicated being supported in their decision to purchase greener technologies as opposed to fourteen who indicated no support.

Appendix XII.24 The Irish Survey.

The Irish Survey.

A similar version of the UK survey was circulated to managers in the Irish FHE sector to establish if the same barriers existed and if they existed to the same extent. Rather than establish what part of the country they worked in, survey respondents were asked to state the name of the organisations for which they worked.

Results.

Sixteen organisation in total were represented and their responses are summarised in Table XII.24.

Table XII.24: Irish Organisations represented in the Survey

Name of Irish Institution	Frequency	Valid Percent
Georgia Tech	1	6.7
EPA	1	6.7
GMIT	1	6.7
RCPI	1	6.7
Waterford I.T.	2	13.3
Smartbay Ireland	1	6.7
St. Patrick's College	1	6.7
An Cheim	1	6.7
NCAD	1	6.7
Quality and Qualifications Ireland	1	6.7
I.T.C	1	6.7
I.T. Tallagh	1	6.7
An Taisce	2	13.3
HEAnet	1	6.7
Total	16	100.0

Analysis of Responses to Irish Institutions.

Fifteen organisation in total were represented; six FHEs, five government organisations and three private ICT consultancies. One respondent chose not to give the name of the organisation they worked for. Those organisations included Georgia Tech Ireland, The Environmental Protection Agency (EPA), The Galway Mayo Institute of Technology (GMIT), The Royal College of Physicians Ireland (RCPI), Smartbay Ireland, Waterford Institute of Technology (WIT), St. Patrick's College, An Chéim, HEAnet, An Taisce, The National College of Art and Design (NCAD), Quality and Qualifications Ireland, Information Technology Consultancy (ITC), and the Institute of Technology Tallaght (IT Tallaght). 40% of survey respondents were from Irish FHEs and more than 46% worked in government organisations with 13% of respondents coming from the private sector. This indicated the results were divided relatively evenly between Irish FHEs and Irish Government organisations and are not as homogenous as results of the UK survey whose respondents were predominantly from FHE institutions.

Job Title of Irish Respondents.

Similar to the UK survey, this question was asked in order to clarify what type of managers were participating in the survey. Survey respondents were asked to indicate from a selection of nine options, their role within their institution.

Results.

Results of this question are summarised in Table XII.25.

Table XII.25: Job Title of Respondents to Irish Survey.

Job Title of Respondents.	Frequency	Valid Percent
ICT/IT Manager (any type)	10	62.5
Estates and Facilities Manager	1	6.3
Procurement/Finance Manager	1	6.3
Other	4	25.0

Total	16	100.0

Analysis of Results.

The majority of respondents were ICT/IT managers with Other managers, Estates and Facilities and Procurement and Finance Managers also responding to a lesser extent. Environmental/Sustainability Managers, Energy Managers, Space Managers, Carbon or Utility Managers participated in the Irish survey.

Length of Time in Current Role.

Irish respondents were also asked about the duration of time in their current role. Respondents were asked to choose from a selection of six options, indicating the number of years in their role at their current institution. Answer options were divided into increments of five years starting at zero and ending at thirty.

Results.

The number of years Irish respondents were in current role are summarised in Table XII.26.

Table XII.26: Number of years Irish respondents were in current role.

Length of time in current role	Frequency	Valid Percent
0-5 years	5	31.3
6-10 years	5	31.3
11-15 years	5	31.3
16-20 years	1	6.3
Total	16	100.0

Analysis of Results.

There is an even distribution of responses from the first three of the categories of years indicating the length of time managers worked in the sector. Only one manger indicated having worked in the sector for between 16 and 20 years.

Number of Years Worked in the University and College Sector.

This question allowed respondents to offer information and knowledge they may have on their total experience working in the Irish FHE sector. It also allowed for the comparison of responses from respondents who may have changed jobs during their careers and how valuable their input might be.

Results.

The number of years respondents worked in the university and college sector are summarised in Table XII.27.

Table XII.27: Number of years in the Irish university and college sector.

Number of years worked in the Irish university and college sector	Frequency	Valid Percent
0-5 years	6	37.5
6-10 years	3	18.8
11-15 years	3	18.8
16-20 years	1	6.3
21-25 years	1	6.3
26-30 years	1	6.3
9.00	1	6.3
Total	16	100.0

Discussions and Evaluation of Responses.

When asked about the approximate number of years spent working in the university and college sector, the majority of survey respondents replied 0-5 years, with those working in the sector between 6 and 10 and 11 and 15 years reaching almost 20%. Just one participant worked in the sector between 16 and 20 years, another 21 to 25 years, and another respondent worked between 25 and 30 years. Results indicated a relatively young workforce with 37.5% (6) of respondents being relatively new to the sector. This is typical of the ICT or IT workforce. As technology is constantly changing, this sector is often filled by recent graduates who possess the knowledge of the most up to date and recent developments in technology. Results indicate a mixture of youth and inexperience that may be accompanied by higher energy levels than those in the middle of their working careers who have gained a considerable amount of experience too. Finally, those in the sector for up to 30 years are likely to have witnessed considerable change over the years and be able to offer real insight into why projects succeed or fail.

Stakeholder Engagement.

Similar to the UK survey the Irish survey included a question related to stakeholder engagement and offered three answer options. The question asked “when implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged i.e. willing to adjust to changes in job roles, train in the use of greener technologies”?

Results.

The responses to the question on stakeholder engagement are summarised in Table XII.28.

Table XII.28: Stakeholder Engagement.

Responses to Stakeholder Engagement.	Frequency	Valid Percent
Yes	7	43.8
No	2	12.5
Neither engaged nor disengaged	7	43.8

Total	16	100.0

Analysis of Responses to Stakeholder Engagement.

Respondents were asked about the level of stakeholder engagement when implementing greener ICT in their institutions. Almost, 44% of respondents stated that staff and students at their institution were engaged and 12.5% stated they were not. This indicated that stakeholder engagement is a barrier but only in minimal amounts. None of the survey respondents stated that they had not tried to implement greener ICT in their institution, indicating that green ICT is widespread in FHEs and government organisations in Ireland. A total of 87% of survey respondents replied either *Yes* or *Neither Engaged nor Disengaged* to being engaged and all sixteen respondents answered this question. This indicated that for the majority of Irish institutions, stakeholders were willing to adapt to changes in their roles in an effort to reduce carbon emissions and running costs. It also showed that each of the Irish FHE and government organisations have implemented the use of greener technologies, on some level.

***Yes* Responses to Stakeholder Engagement.**

It was important to establish why stakeholders engaged with greener ICT in Irish institutions so comparisons could be made with their UK counterparts. It would also provide useful information when implementing further sustainable initiatives across campus, (ICT related or otherwise).

Results.

Of the 8 eight respondents that answered *Yes* to the stakeholder engagement question, their reasons for doing so are summarised in Table XII.29.

Table XII.29: Reasons for *Yes* to Stakeholder Engagement" answers.

Reasons for *Yes* to Stakeholder Engagement" answers	Frequency	Valid Percent

Stakeholders were informed of switch to greener technology and felt included in the decision-making process.	4	44.4
Older technologies were starting to slow down/fail so stakeholders welcomed newer, faster ICT equipment	3	33.3
Stakeholders supported any initiative that reduced energy bills and carbon emissions.	2	22.2
Total	9	100.0

(*This table is reading cumulatively. SurveyMonkey indicates that total respondents are seven yet the chart and table indicate nine responses, this is because at least two people chose more than one answer option).

Discussions and Evaluation of Yes Responses to Stakeholder Engagement.

When asked why they answered Yes to the question on stakeholder engagement, more than 44% of survey respondents stated it was because stakeholders were informed of the reasons why the switch to greener technology was being made and felt included in the decision-making process. More than 33% stated it was because their institutions' older technologies were starting to slow down or fail, so stakeholders welcomed newer, faster ICT equipment. More than 22% stated it was because stakeholders supported any initiative that reduced energy bills and carbon emissions. The majority of stakeholders were engaged because they felt included in their decision-making process and they were experiencing problems with their existing equipment. More than 33% stated that it was because older technology was slowing down and/or failing so newer faster technology was preferred. Less than 23% stated that their decision to become engaged was due to concern for the environment. This is typical of an ICT / IT managers' responses as their primary responsibility is to provide ICT / IT services and to ensure computer labs, servers, AV equipment are set-up correctly and are in working order. ICT energy demand and/or their environmental footprint is secondary to their remit.

Neither Engaged nor Disengaged Responses to Stakeholder Engagement.

It was equally important to establish why some respondents answered neither engaged nor disengaged when asked about implementing green ICT in their institutions. It would offer useful information when implementing future initiatives.

Results.

Responses to *Neither Engaged nor Disengaged* question are summarised in Table XII.30.

Table XII.30: Reasons for *Neither Engaged nor Disengaged* answers.

Reasons for being *Neither Engaged nor Disengaged*	**Frequency**	**Valid Percent**
Stakeholders were not informed of the changes to greener ICT, they happened gradually over the course of the year(s).	4	66.7
Stakeholders didn't really have an opinion on the switch to greener ICT, some protested, others supported it etc.	2	33.3
Total	**6**	**100.0**

Analysis of Responses to Neither Engaged nor Disengaged to Stakeholder Engagement.

Almost 67% of survey respondents stated that stakeholders answered neither engaged nor disengaged with green ICT because they were not informed of the changes to greener ICT. They happened gradually over the course of a few years. Almost 34% stated that it was because their stakeholders did not really have an opinion on the switch to greener technology, some protested, some were vocal supporters but most said nothing. These results indicate a general attitude of ambivalence towards the uptake of green ICT by Irish FHEs' and managers of government and privately owned organisations. As long as disruption to services are minimal and any new technology being installed works, stakeholders will be engaged.

***No* Responses to Stakeholder Engagement.**

Similar to previous *Yes* and *Neither Engaged nor Disengaged* responses, it was equally important to establish why respondents answered *No* to stakeholder engagement. Responses would prove just as useful when implementing sustainable initiatives as they highlighted issues to be avoided.

Results.

Respondents were asked choose from four answer options below as to why they thought stakeholders at their institution were not supportive of the switch to greener ICT. Responses are summarised in Table XII.31.

Table XII.31: *Summary of No* Responses to Stakeholder Engagement.

***No* Responses to Stakeholder Engagement.**	**Frequency**	**Valid Percent**
Switching to greener ICT resulted in disruption to services.	0	0
Stakeholders did not like adjusting to green ICT initiatives such as duplex printing and copying, etc.	1	100.0
Switching to greener ICT required behavioural change such as Printing and Copying etc.	0	0
Stakeholders expressed their lack of confidence in "green ICT" i.e. new technology is not very green.	0	0
Total	16	0

Analysis of No Responses to Stakeholder Engagement.

Only one of the two survey respondents who answered *No* to stakeholder engagement, answered this question and answered that staff at their institution did not like adjusting to green ICT initiatives such as duplex printing and copying.

Managers at Irish FHEs, government and privately owned organisations are not fully engaged with green ICT, but only at a minimal level. This low level of engagement is not because switching to greener ICT results in disruption to services, requires behavioural change or is as a result of a lack in confidence in the performance of sustainable technology. Instead it indicates that managers at Irish FHE, government and privately owned organisations believe in the cost and carbon savings that sustainable technologies promise to deliver on. It also indicates that stakeholders are willing to engage in behavioural change to the betterment of their institution, but do not necessarily enjoy it.

XII.32 Culture of Green ICT.

This question was asked to establish if culture was a barrier to participating in sustainable ICT projects in Irish institutions. For some institutions, their culture can be helpful when implementing sustainable ICT initiatives, for others it is a hindrance.

Results.

Results of that's question are summarised in Table XII.32.

Table XII.32: Culture of Green ICT in Irish Institutions

Responses to Culture of Green ICT in Irish Institutions	Frequency	Valid Percent
Yes	6	42.9
No	3	21.4
Neither typical or non-typical	5	35.7
Total	14	100.0

Analysis of Responses to Culture of Green ICT.

When asked if participating in green ICT projects was typical of their institutions' culture, almost 43% (6) stated that it was, more than 21% (3) stated it was not and more than 35% stated that it was neither typical nor non typical. This larger

percentage of *Yes* responses combined with an almost equally large percentage of neither engaged nor disengaged responses, indicates that participating in green ICT projects was typical of the culture of more than 78% of Irish institutions.

XII.33 *Yes* Responses to Culture of Green ICT.

Of those which answered *Yes* to green ICT being part of their institutions culture, survey respondents were then asked why they answered *Yes* and were given two answer options. Responses to that question are summarised in Table XII.33.

Table XII.33: Reason for Green ICT Culture in Irish Institutions.

Reasons for *Yes* Responses to Culture of Green ICT.	Frequency	Valid Percent
We have very innovative and proactive senior manager(s) who encourage participation in sustainable projects.	4	80.0
Our institution is a leader in ICT research with strong links to other research organisations.	1	20.0
Total	5	100.0

Analysis of *Yes* Responses to Culture of Green ICT.
Of the survey respondents who answered *Yes* to Green ICT being part of their institutions culture, 80% stated that it was due to having very innovative and proactive senior managers who encouraged participation in sustainable projects, green ICT or otherwise. The remaining 20% stated that it was because their institution was a leader in ICT research with strong links to other research organisations, so participating in a green ICT project was normal. This shows that when staff are passionate, forward thinking and adequately resourced, barriers are easily overcome. Respondents did not offer any comments relating to these questions.

XII.34 No Responses to Culture of Green ICT.

Survey respondents who answered *No* to Green ICT being part of their institution culture were asked why they answered *No*. Respondents were given a choice of two possible answer options that included institutions' senior managers not being interested in participating in sustainable projects,(green ICT or otherwise) or institutions being very traditional in the subjects taught and rarely deviating from them.

Results.

Responses to this question are summarised in Table XII.34. For the purpose of this research, the word institution includes government and privately owned organisations.

Table XII.34: Reasons for absence of Green ICT Culture in UK Institutions.

Reasons for absence of Green ICT Culture in Irish Institutions.	**Frequency**	**Valid Percent**
Senior management not interested in green ICT projects	2	100.0
Traditional in the subjects it teaches and rarely deviates from them.	0	0
Total	2	

Analysis of *No* Responses to Culture of Green ICT.
For those who answered *No* to Green ICT being part of their institutions culture, each of them stated that it was because their institutions' senior managers were not interested in participating in sustainable projects, green ICT or otherwise. No further comments were left regarding this question. While the number of responses from managers were low, just two responses indicated lacking managers are a barrier to participation in sustainable ICT projects.

"Neither Typical nor Not-Typical" Responses to Culture of Green ICT. Respondents who answered "Neither Typical nor Not-Typical" when asked about Green ICT being part of their culture left the following comments.

- Some green projects are adopted, some are not
- Participating in initiatives such as these normally requires an evangelist who will do most of the running. Once a given project is over then we tend to wait for another one to come along that captures somebody else's imagination to run with.
- It is not yet identified as sole responsibility of anyone to do this.
- It's not a priority focus and has not been on the main work list

Analysis of Responses to "Neither typical nor Not-typical" of Culture of Green ICT.

Four respondents left comments indicating that a selection of green ICT initiatives are occasionally adopted depending on the availability, resources and passion of staff managing the project. They also highlighted the fact that sustainability is not the core business of organisations and is therefore not always a priority.

Appendix XII.35 Government Organisations as Drivers.

Respondents were asked to grade from a list of eight government organisation and one *Other* organisation how they affected their institutions' ability to participate in Green ICT projects. This question was asked to establish if any of the Irish organisations acted as drivers for change and if they also offered support when participating in sustainable ICT projects. Respondents were given a choice of 5 answer options: Excellent Driver; Good Driver; Neither a Good nor Bad Driver; Poor Driver or a Very Poor Driver. Responses to this question are summarised in Tables XII.35(i), (ii), (iii), (iv), (v), (vi), (vii), (viii) and (ix).

Table XII.35(i): The Higher Education Authority Council (The HEAC).

HEAC	Frequency	Valid Percent
Excellent Driver	0	0
Good Driver	2	16.7
Neither a Good nor Bad Driver	4	33.3
Poor Driver	5	41.7
Very Poor Driver	1	8.3
Total	12	100.0

Table XII.35(ii): HEAnet

HEAnet	Frequency	Valid Percent
Excellent Driver	0	0
Good Driver	3	25.0
Neither a Good nor Bad Driver	6	50.0
Poor Driver	3	25.0
Very Poor Driver	0	0
Total	12	100.0

Table XII.35(iii): Environmental Protection Agency.

EPA	Frequency	Valid Percent
Excellent Driver	2	16.7

Good Driver	4	33.3
Neither a Good nor Bad Driver	3	25.0
Poor Driver	3	25.0
Very Poor Driver	0	0
Total	12	100.0

Table XII.35(iv): Office of Government Procurement.

Office of Government Procurement	Frequency	Valid Percent
Excellent Driver	0	0
Good Driver	3	25.0
Neither a Good nor Bad Driver	4	33.3
Poor Driver	4	33.3
Very Poor Driver	1	8.3
Total	12	100.0

Table XII.35(v): Institute of Technology Ireland.

I.T Ireland	**Frequency**	**Valid Percent**
Excellent Driver	0	0
Good Driver	1	8.3
Neither a Good nor Bad Driver	7	58.3
Poor Driver	4	33.3
Very Poor Driver	0	0

Total	12	100.0

Table XII.35(vi): Irish Universities Association (IUA).

IUA	Frequency	Valid Percent
Excellent Driver	0	0
Good Driver	1	8.3
Neither a Good nor Bad Driver	7	58.3
Poor Driver	4	33.3
Very Poor Driver	0	0
Total	12	100.0

Table XII.35(vii): Non-Governmental Organisations.

NGO's	Frequency	Valid Percent
Excellent Driver	1	7.7
Good Driver	3	23.1
Neither a Good nor Bad Driver	6	46.2
Poor Driver	3	23.1
Very Poor Driver	0	0
Total	13	100.0

Table XII.35 (viii): Local Authorities.

Local Authorities	Frequency	Valid Percent
Excellent Driver	0	0
Good Driver	3	25.0
Neither a Good nor Bad Driver	4	33.3
Poor Driver	4	33.3
Very Poor Driver	1	8.3
Total	12	100.0

Table XII.35(ix): Other.

Other	Frequency	Valid Percent
Excellent Driver	0	0
Good Driver	1	16.7
Neither a Good nor Bad Driver	4	66.7
Poor Driver	1	16.7
Very Poor Driver	0	0
Total	6	100.0

Analysis of Responses to Government Organisations as Drivers.

Results indicate mixed opinions from survey respondents regarding their government organisations' ability to drive participation in green ICT projects. Responses vary from some organisations being considered an excellent driver to

also being considered a very poor driver. Results regarding the HEAnet, as an organisation that has affected the participation of institutions in green ICT projects and as a driver for change, are also mixed. However the range of opinions are narrower with responses varying from the HEAnet being a good driver to being a poor driver. Results regarding the EPA as an organisation that has affected the participation of institutions in green ICT projects and as a driver for change are also mixed. The range of opinions are broader with at least two managers, almost 17%, stating that the EPA was an excellent driver, 33% (4) stating it was a very good driver and the same amount, 25% (3), stating they were neither a good nor a bad driver and a poor driver. The *neither good nor bad driver* and *poor driver* responses are surprising as it is the responsibility of the EPA to ensure organisations operate as sustainably as possible. The EPA has an extensive remit where responsibility to the environment is concerned, but the use of more sustainable technologies appears not to be part of that remit. In addition, as no environmental or sustainable managers participated in the survey and as it is they who typically work more closely with the EPA they are likely to have a different opinion. Results are similar to that of other government organisations, with managers indicating that the Irish Office of Government Procurement was considered anywhere from being a good driver to being a very poor driver and each of the answer options in-between. As the Office of Government Procurement does not typically deal with ICT or IT, Utility or Estates and Facility's managers, responses might not reflect the organisations' true ability to support institutions in participating in sustainable ICT projects and might therefore be considered a barrier whereas in reality, it is not. Results regarding the Institution of Technology Ireland as an organisation that has affected the participation of institutions in green ICT projects and as a driver for change were also mixed.

However, the range of opinions were narrower with just three answer options being chosen, varying from the Institution of Technology Ireland being a good driver to being a poor driver. Results were limited to just three out of a possible five answer options with the majority of survey respondents indicating they were neither a good nor a bad driver. Only one survey respondent stated the Institute of Technology was a good driver and four stated it was a poor driver. The variation of results are broader and include responses in four out of five categories of answer options going from being an excellent driver to a poor driver. The majority of managers 37.5% (6) who answered this question indicated that Non-Governmental Organisations were neither good nor bad drivers.
Just one manager stated they were a good driver and three stated they were a poor

driver. The variation of responses are again, limited to just four of a possible five categories of answer options, this time from good driver to very poor driver. Also as no list of non-government organisations was given, survey respondents could have been referring to different organisations as they answered this question.The majority of managers who answered this question also indicated that local authorities were neither a good nor bad drivers and poor drivers in equal amounts. Three managers considered them to be good drivers and just one manager considered local authorities to be a very poor driver. As regards *Other* drivers, six managers in total offered replies to this question and the variation of results were limited to just three categories of answer options, this time from good driver to poor driver. 25% (4) managers who answered this question indicated that *Other* organisations were neither a good nor bad drivers and poor drivers in equal amounts. Just one manager considered them to be a good driver and just one stated they were a very poor driver.

Summary of Discussions and Evaluation of Responses to Government Organisations Drivers.

'When asked about each of the nine organisations and their effect on institutions' participation in green ICT projects, respondents choose from five answer options: Excellent Driver, Good Driver, Neither a Good Nor a Bad Driver, Poor Driver or Very Poor Driver. Overall the results were mixed indicating a variation in by each of the institutions when dealing with each of the government organisations. Only the Environmental Protection Agency (EPA) and Non-Governmental Organisations were indicated as being excellent drivers and only the Local Authorities and the Office of Government Procurement were listed as being very poor drivers. However there were some extreme results. Two survey respondents indicated that the EPA was an excellent driver and one participant indicated that non-governmental organisations were excellent drivers, although failed to leave a comment indicating which organisation that might be. In contrast, Local authorities, The HEA and the Officer of Government Procurement were each considered to be very poor drivers and each of the other eight organisations listed. Examining and summarising the results from a broader perspective, each of the organisations was predominantly considered to be any of the three "middle-spectrum" answer options, indicating it was considered a good, neither good nor bad and/or a poor driver. It can be evaluated that the mixed set of results were due to each individual survey participant having different experiences dealing with each of the organisations. Overall there were no government organisations in the Republic of Ireland that acted as a

significant driver for sustainable ICT projects in the same manner that JISC was a driver for greener ICT in UK FHEs.

Appendix XII.36 Green Technology Delivering on Financial and Carbon Savings in Irish Institutions.

This question was asked in order to establish if the reputation of Green ICT as a cost and carbon saving initiative was proving to be a barrier in Irish institutions, or not. See Table XII.36.

Table XII.36: Green Technology Delivering on Financial and Carbon Savings.

Green Technology Delivering on Financial and Carbon Savings.	Frequency	Valid Percent
Yes	2	16.7
No	3	25.0
Somewhat	7	58.3
Total	12	100.0

Discussions and Evaluation of Green Technology Delivering on the Financial and Carbon Savings.

When asked if they felt that green technology delivers on the financial and carbon savings promised by IT companies, almost 60% of survey respondents stated that they somewhat did, almost 17% (2) answered *Yes* and 25% (3) answered *No*. Overall the response was positive towards the use of Green ICT as regards being a cost and carbon saver. By combining the *Yes* and *Somewhat* responses together, the overall score is 75%, a significant majority in favour of the use of green ICT. Only one person left a comment, but it did not directly pertain to the benefits of the use of green ICT. In order to gain a better understanding of the extent to which institutions implemented greener technologies, a follow-on question asked respondents to choose from a list of green ICT initiatives implemented at their institution and

respondents were invited to choose more than one where applicable. Eight respondents answered this question with eight choosing to skip it.

Appendix XII.37 Yes or Somewhat Responses.

For those who answered *Yes* or *Somewhat* to the question on performance of green ICT, respondents were then asked to choose from a list of Green ICT initiatives they had implemented at their institution. Survey respondents were invited to tick more than one answer option where applicable. A detailed account of the Irish survey responses to this question is summarised in Table XII.37.

Table XII.37: Green ICT initiatives implemented in Irish Institutions.

Green ICT initiatives implemented in Irish Institutions	Frequency	Valid Percent	Percentage of responses who indicated using it.
Automatic switch off/powerdown of PCs when not in use.	3	5.6	37.50%
Automatic switch off/powerdown of PCs at 5pm/end of work day	3	5.6	37.50%
Print and Copy double sided by default	6	11.1	75.00%
Virtualisation of servers	8	14.8	100.00%
Cloud Computing	7	13.0	87.50%
Installation of greener data centres	4	7.4	50.00%

Switch to use of shared services	7	13.0	87.50%
Switch to Thin Client Technology (servers, PCs etc.)	1	1.9	12.50%
Switch to BYOD (Bring Your Own Device)	1	1.9	12.50%
Video Conferencing	7	13.0	87.50%
Greener networks (switches, cables etc.)	2	3.7	25.00%
Switch to MFDs (multifunctional devices) for printing, copying, scanning etc.	4	7.4	50.00%
Introduction of "Hot-Desking" and "Hoteling" (reserving a hot-desk)	1	1.9	12.50%
Total	54	100.0	37.50%

Percentage of Respondents Who Implemented Various Types of Green Technology.

Analysis of *Yes* and *Somewhat* responses to Green ICT Delivering on Financial and Carbon Savings.

Results were mixed with Cloud based technologies (virtualisation of servers, shared services and cloud computing) proving to be the most widely implemented initiative. For easier quick wins, printing and copying double-sided by default and video

conferencing were common. These two technologies facilitated savings on paper and time. Any technology that allows for multiple savings are likely to prove popular and this was supported in the single comment that was left for this question. The move to virtualisation of servers, shared services and cloud computing proved to be the most popular, indicating a move to the greater and more confident use of such technologies. Their popularity is often as the move results in less work for the technicians as the responsibility is placed on large organisations such as Amazon, Google or Microsoft. Another outcome was the uptake of a technology that allows for the saving of time and space with relative ease, namely video conferencing and double-sided printing and copying. As both technologies come as standard in newer devices or are a free service (SKYPE, Viber) and allow for a more convenient work-life balance, this makes their uptake more likely.

Appendix XII.38 *No* Responses to Green Technology Delivering on Financial and Carbon Savings.

Respondents who answered *No* to the question relating to performance of green ICT, were then asked to choose from three answer option why this was the case and could choose more than one answer option. Those responses are summarised in Table X II.38.

Table XII.38 Reasons for *No* Responses to Performance of Green ICT.

Reasons for *No* responses to performance of green ICT	**Frequency**	**Valid Percent**
Could not see a reduction in energy costs.	0	0
Purchase costs far exceeded any savings made	3	75.0

By the time R.O.I was realised, technology was out of date	1	25.0
Total	4	100.0

Analysis of No Responses to Green ICT Delivering on Financial and Carbon Savings.

Of the survey respondents that replied *No* to Green ICT delivering on the financial and carbon savings promised by IT companies, 100% stated it was because the purchase costs far exceeded any savings made. 33% stated it was also because by the time the return on investment was realised, the technology are out of date. None of the survey respondents stated that it was due to their not being able to see a reduction in energy costs. Only three respondents answered this question with none of them leaving a comment and the remaining thirteen choosing to skip the question. Respondents were invited to give more than one answer option and overall results indicated that initial purchase costs of sustainbale technology is not cost effective when compared to eventual savings made. The general consensus within the FHE sector is that as soon as a more sustainable piece of technology is purchased and implemented, a more advanced and more sustainble alternative is released on the market shortly thereafter. This sentiment was also evidenced in the UK survey.

Appendix XII.39 Cuts in Funding.

Survey respondents were also asked if they thought that cuts in funding to the educational sector affected their institution's ability to participate in sustainable ICT projects. Respondents were offered three answer options to choose from *Yes, No or Somewhat* and responses to that question are summarised in the Table XII.39.

Table XII.39 Have recent cuts in funding to the educational sector affected your institutions ability to participate in sustainable ICT projects?

Affected by Cuts in Funding	Frequency	Valid Percent
Yes	5	45.5

No	5	45.5
Somewhat	1	9.1
Total	11	100.0

Discussions and Evaluation of Responses Cuts in Funding.

When asked if recent cuts in funding to the educational sector affected their institution's ability to participate in sustainable ICT projects, respondents replied both *Yes* and *No* in equal measuresof 45% (5). Just over 9% (1) stated that it had somewhat affected their institutions. Eleven respondents answered this question, five chose to skip the question and just one respondent left a comment. The results are similar to that of the UK which was surprising, as the survey was circulated after one of the worst recessions in Ireland in recent years where the public sector was particularly affected by budget cuts.
The *No* answers indicated that respondents had not, or were not, participating in sustainable ICT projects, but as there was no follow-on question asking respondents to explain their replies, there is an element of uncertainty. The single comment that was given stated that "massive cuts have removed any possibility of reviewing these types of technologies"

Appendix XII.40 Purchasing Frameworks.

When asked about their institution being part of a framework that included criteria for the purchase of sustainable technology, respondents were asked if they felt supported or not in their choices of purchasing more sustainable technology.

Respondents were asked to choose their answers from a choice of six possible answers and those answer options and their response rates are summarised in the Table XII.40.

Table XII.40: Membership of Purchasing Framework and Support for Sustainable Technology?

Membership of Purchasing Framework and Support for Sustainable Technology?	Frequency	Valid Percent
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT	2	18.2
Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT	1	9.1
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT	2	18.2
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	1	9.1
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT	5	45.5
Total	11	100.0

Analysis of Responses to Purchasing Frameworks.

18.2% (2) of respondents stated that they were part of a framework and felt supported in their decisions to purchase green ICT. 9.1% (1), stated that they were part of a framework but did not feel supported in decisions to purchase green ICT. 18.2% (2) stated that they were not part of a framework, but still felt supported in their decisions to purchase green ICT. None of the respondents indicated not being part of a framework and not feeling supported in decisions to purchase green ICT. 9.1% (1) indicated they were not sure if they were are part of a framework, but felt supported in their decisions to purchase green ICT regardless. Finally, 45.45% (5) indicated being part of a framework, but not feeling supported in decisions to purchase green ICT. The mixture of replies may be due to the variety of frameworks available in The Republic of Ireland and how each of the respondents engaged with them.

Overall the outcomes show that despite being part of a purchasing framework, managers may still experience a lack of support. This further indicated two barriers,

i.e. lacking managers and poor stakeholder engagement. Similarly, not being part of a framework does not necessarily equate to lacking management as support to purchase sustainable technology may still be in place, indicating that passionate well-resourced staff and good stakeholder engagement can overcome barriers of not having a framework in place.

Appendix XII.41 Lacking Managers.

Survey respondents were asked about the performance of their ICT managers and if they felt their managers were “lacking" by exhibiting any of a series of seven characteristics. Responses to this question would identify possible underperformance of ICT managers and how this was subsequently responsible for poor or no participation in sustainable ICT projects. Survey respondents were asked this questions to establish if their ICT managers were lacking and in what area were they lacking? The responses are summarised in Table XII.41.

Table XII.41: Lacking Characteristics of Irish ICT Managers.

Characteristics of Lacking ICT Mangers.	Frequency	Valid Percent
Poor Knowledge of Green ICT	0	0
Disinterest in green ICT initiatives	3	12.0
Disinterest in "outside" green ICT projects (i.e. participating not requested from senior management)	2	8.0
Is negatively influenced by institutional politics	3	12.0
Is under-resourced in terms of funding for new technology	6	24.0
Is under resourced in terms of allocation of support staff	4	16.0
Is under resourced in terms of allowances for staff training, upskilling, etc.	4	16.0

None of the above	3	12.0
Total	25	100.0

Analysis of Responses to Lacking Managers.

None of the participants indicated that poor knowledge of green ICT issues was a barrier. 12% (3) indicated a disinterest in green ICT initiatives with more than 8% (2) stating a disinterest in "outside" green ICT projects (i.e. participating in ICT projects not requested by senior management). 12% (3) were negatively influenced by institutional politics. 24% (6) were under-resourced in terms of funding for new technology, 16% (4) were under-resourced in terms of allocation of support staff and the same amount were under-resourced in terms of allowances for staff training, upskilling. Just three respondents (12%) answered that managers in their institutions were not lacking any of the listed ways and none of the survey respondents left a comment regarding this question. The hybrid of responses with little or no funding for new technologies being the greatest issue for mangers, followed by under-resourcing for upskilling, training and hiring support staff indicate not only the barrier of the “Lacking Manager” but also the barrier of cuts in funding. Other managerial issues underpinning lacking characteristics included institutional politics and disinterest in green ICT issues. Overall, results indicate that lacking managers is a barrier to institutions participating in sustainable ICT projects and the term lacking incorporates a variety of institutional issues, each a barrier in their own right.

Chapter 5 Part (II): Data Analysis of Results

This section gives a comparison and Evaluation of the Data and Results.

This is a quantitative study of the UK and Irish surveys.

Appendix XII.42 UK Vs Ireland. Comparison of Job Titles between UK and Irish Respondents.

It was decided to compare the results of the surveys from three different aspects. Those aspects included a comparison of

4. Ireland versus The UK responses, to establish a series of similarities and differences between the two datasets, thereby identifying any cultural divides or likenesses.
5. Responses from managers in London institutions versus those located in the rest of the UK. This was to establish any similarities or differences between the two UK locations. Another reason for this comparison was the fact that the majority of respondents in the UK survey were from London institutions and the researcher decided to make this the focus of an analysis.
6. Responses from ICT/IT managers versus Environmental/Sustainable managers versus Other managers. This was to also establish any similarities or differences between the three categories of job roles. The three job roles were chosen as they were the three categories of managers with the greatest number of respondents.

Also for multiple choice questions where respondents chose more than one answer option, those responses were added together to give a more truthful result regarding the popularity of a particular answer option, i.e. the mode of the answer option was given greater consideration as oppose to its percentage in comparison to number of respondents. (Data in tables regarding total number of responses may differ slightly from data in SurveyMonkey regarding total number of respondents in appendices)

Results.

1. Ireland versus the Rest of the UK Responses.

The first question was deemed incomparable as it asked a different question for the UK and Irish survey. The UK survey questioned institutions' regional location across the UK, whereas the Irish survey asked respondents to simply name the organisation they worked for.

The second question was comparable as it compared job roles between the two countries. Respondents were asked which title below best describes their current role at their institution and offered nine possible answer options. Respondents were only allowed to choose one answer option and a comparison of answer responses are summarised in the table below.

Table XII.42 Comparison of Job Titles between UK and Irish Respondents

Job Role	Number of UK Respondents	Number of Irish Respondents
ICT/IT Manager	11 (18.34%)	10 (62.5 %)
Environmental/Sustainable Manager	15 (25%)	0
Energy Manager	3 (5 %)	0
Space Manager	0	0
Estates and Facilities Manager	2 (3.33%)	1 (6.25 %)
Procurement/Finance Manager	2 (3.33%)	1(6.25 %)
Carbon Manager	0	0
Utilities Manager	1 (1.67%)	0
Other	26 (43.33%)	4 (25%)
Total	**60**	**16**

Analysis of UK Vs Ireland Responses to Role at Institution.
As can be seen from Table XII.42 the category of ICT/IT managers in the Republic. of Ireland had the greatest populous of survey respondents. For the UK survey it

was Other managers. Estates and Facilities Managers and Procurement/Finance Managers from both countries also took part but only at a minimal level. Utilities managers from the UK also took part. However, Space Managers and Carbon Managers from both countries did not participate in the survey and the Irish survey was also devoid of input from Environmental/Sustainable Managers, Energy Manager and Utilities managers. These results indicate either poor participation from certain categories of managers, particularly in the Republic of Ireland, or certain institutions do not employ these types of managers but are instead under the remit of other managers.
For example the Energy Manger in some institutions is also the Carbon Manager and carries out many of the environmental /sustainable tasks too.

Appendix XII.43 Length of time in Current Role.

A comparison of the six categories regarding length of time, which respondents from both countries had been in their current role, was carried out. This was done in order to establish which country had managers that had been in their roles the longest and may or may not have affected their responses to questions. A comparison of datasets are summarised in the Table XII.43.

Table XII.43 Comparison of Number of years in Current Job Role between UK and Irish Respondents.

Length of time in Current Job Role	UK (60)	Ireland (16)
0-5 years.	33 (55%)	5 (31.25%)
6-10 years.	15 (25%)	5 (31.25%)
11-15 years.	4 (6.66%)	5 (31.25%)
16-20 years.	4 (6.66%)	1 (6.25%)
21-25 years.	2 (3.33%)	0
26-30 years.	2 (3.33%)	0
Total.	**60**	**16**

Analysis of Comparison of Length of Time in Current Role.

The majority of UK FHE managers were in their roles five years or less indicating a workforce with relatively few years of experience.
The number of managers declined significantly (by approximately 50-75% with each decade) as the length of time in their roles increased.
In contrast, the number of Irish managers remains the same as the length of time in their roles increases, but then declines to just 6.25% (1) for managers with 16-25 years' experience and then to zero for managers with greater than 21 years experience. This indicates that respondents of the Irish survey are from managers with only 20 years experience, or less, in their job role.

Appendix XII.44 Length of Time in FHE Sector.

A similar comparison was also made examining the length of time in the FHE sector that respondents from each country had worked, was carried out. This was done in order to establish which of the two countries had respondents who worked in the sector the longest. Respondents were asked the approximate number of years they had worked in the university and college sector and their responses are summarised in Table XII.44.

Table XII.44 Comparison of number of years in the sector between UK and Irish Respondents.

Number of years in the university and college sector.	**UK**	**Ireland**
0-5 years	20 (33.33%)	6 (37.5%)
6-10 years	14 (23.33%)	3 (18.75%)
11-15 years	13 (21.66%)	3 (18.75%)
16-20 years	4 (6.66%)	1 (6.25%)
21-25 years	5 (8.33%)	1 (6.25%)
26-30 years	4 (6.66%)	2 (12.5%)
Total	**60**	**16**

Analysis of Comparison of Length of Time in the University and College Sector.

Table XII.44 indicates that the majority of UK FHE managers have been working in the sector for five years or less. As the numbers of years increase, the number of survey respondents decreases with the result that only four of the UK survey respondents are working in the FHE sector after 26 years. Similarly, in the Irish survey, the majority of respondents had been working in the sector for five years or less.

As the number of years worked in the sector increases, the number of survey respondents decreases with the result that only one Irish survey respondent worked in the FHE sector for twenty-five years. However, the number then increased to 12.5% (2) in the 26-30 years category. Similarly in the UK survey, respondents in the 21-25 years category increased from 6.66% (4) to 8.88%(5) in the 16-20 years category. The patterns in number of years worked in the sector by both UK and Irish respondents indicate a similar, if slightly erratic pattern in the data but is not unusual.

Appendix XII.45 Stakeholder Engagement.

Responses from both surveys relating to the question on stakeholder engagement were compared to establish the disparity, if any, between respondents from both countries.

Respondents were asked “when implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged i.e. willing to adjust to changes in job roles, train in the use of greener technologies etc.? A summary of the comparison of those results is shown in Table XII.45.

Table XII.45 Comparison of Responses to Stakeholder Engagement in Green ICT Projects UK and Irish Institutions.

Stakeholder Engagement.	UK	Ireland
Yes.	18 (36.73%)	7 (43.75%)

No.	6 (12.24%)	2 (12.5%)
Neither Engaged nor Disengaged.	25 (51.04%)	7 (43.75%)
We have not tried to implement greener ICT in our institution.	0	0
Total	**49**	**16**

Analysis of Comparison of Responses to Stakeholder Engagement.

The results are similar for surveys from both countries. Large percentages of responses indicating stakeholder engagement when implementing greener ICT initiatives, were found, except in the UK survey where more than half (51.04%) of the survey respondents indicated that stakeholders were *neither engaged nor disengaged*. In contrast, managers from Irish institutions answered that stakeholders were both *engaged* and *Neither Engaged nor Disengaged*, in equal amounts. Institutions from both countries indicated that they had tried to implement initiatives indicating an awareness of greener ICT and a willingness to reduce carbon emissions and running costs.

Appendix XII.46 Comparison of Yes Responses Stakeholder Engagement.

As before, survey respondents who answered *Yes* to Stakeholder Engagement were then asked to choose from four answer options why they chose that answer. The researcher then decided to compare the *Yes* responses from UK and Irish Institutions. A summary of the comparison of those responses are given in Table XII.46.

Table XII.46 Comparison of *Yes* Responses to Stakeholder Engagement in UK and Irish Institutions.

Yes to Stakeholder Engagement.	**UK**	**Ireland**

Stakeholders were informed of the reason(s) why the switch to greener technology was being made and felt included in the decision-making process.	12 (37.5%)	4(44%)
Older technologies were starting to slow down/fail so stakeholders welcomed newer, faster ICT equipment.	9 (28%)	3(33%)
Stakeholders supported any initiative that reduced energy bills and carbon emissions.	11(34%)	2(22%)
Total	**32**	**9**

Analysis of Comparison of Yes Responses to Stakeholder Engagement.

Results from institutions in both countries were similar in that each of the *Yes* answer options resonated with respondents from both countries, albeit to varying degrees. Informing stakeholders of a transition to the use of greener technologies as a method of engagement was key for engagement in both countries. However, stakeholders at UK institutions appeared to support any initiative that reduced energy bills and carbon emissions more so than replacing older technologies that had started to slow down or fail. In Irish institutions, this proved to be less of a reason for engagement and more so that stakeholders were informed of why a switch to greener technology was being made as well as feeling included in the decision-making process.

Appendix XII.47 Comparison of No Responses to Stakeholder Engagement.

A comparison was made between the four different answer options that respondents from both countries who answered *No* to stakeholder engagement gave, and are summarised in Table XII.47.

Table XII.47 Comparison of *No* Responses to Stakeholder Engagement in UK and Irish Institutions.

Comparison of *No* Responses to Stakeholder Engagement.	**UK**	**Ireland**
Switching to greener ICT resulted in disruption to services.	0	0
Stakeholders did not like having to adjust to green ICT initiatives such as printing and copying double sided, communicating electronically instead of using paper etc.	0	1 (100%)
Switching to greener ICT required behavioural change such as Printing and Copying double sided or eliminating paper use where possible, communicating using technology as oppose to travelling long distances, sharing user services as opposed to exclusive ownership of technologies and equipment etc.	2 (40%)	0
Stakeholders expressed their lack of confidence in "green ICT" i.e. new technology is not very green.	3 (60%)	0
Total	**5**	**1**

Analysis of Comparison of No Responses to Stakeholder Engagement.

Results from both the UK and Irish surveys differed, as regards the percentage response rate for each answer. While total number of responses did not exceed five for either survey, neither stated that switching to greener ICT resulted in disruption to services. However they differed in that only the Irish institutions indicated that stakeholders did not like having to adjust to green ICT initiatives and only UK institutions indicated that switching to greener ICT required behavioural change or that stakeholders expressed their lack of confidence in "green ICT", i.e. new technology not being very green. This indicates that stakeholders from both countries differ in their inability to engage with greener ICT, but respondent from both countries agree that switching did not necessary lead to a disruption of services.

Appendix XII.48 Comparison of Neither Engaged nor Disengaged responses to Stakeholder Engagement.

One of the answer options to the question on stakeholder engagement was being *Neither Engaged nor Disengaged*. The researcher chose to compare the responses from both countries to establish if a disparity or similarity between the two countries existed. Results are summarised Table XII.48.

Table XII.48.Comparison of Neither Engagement nor Disengagement of Green ICT in UK and Irish Institutions.

Neither Engaged nor Disengaged to Stakeholder Engagement.	**UK**	**Ireland**
Stakeholders were not informed the changes to greener ICT, they happened gradually over the course of the year(s).	10 (42%)	4 (66.6%)
Stakeholders didn't really have an opinion on the switch to greener technology, some protested, some were vocal supporters, most said nothing.	14 (58%)	2 (33.3%)
Total	**24**	**6**

Analysis of Comparison of Neither Engaged nor Disengaged Responses.

Results differed for institutions from both countries as the majority of respondents in the UK survey, 58% (14) stated that their stakeholders did not really have an opinion on the switch to greener technology, some protested, some were vocal supporters, most said nothing. However, stakeholders' ambivalence in Irish institutions was mainly due to *not* being informed of the changes to greener ICT. Changes happened gradually over the course of the year. Respondents in both the UK and Irish surveys also indicated that their stakeholders' ambivalence and disinterest in green ICT was due to them not really having an opinion on the switch to greener technology, with some protesting, some being vocal supporters, but most saying nothing, albeit to a lesser extent.

Appendix XII.49 Culture of Green ICT .

A comparison was made between the UK and Irish responses to the question relating to having a culture of green ICT at their respective institutions. Answer options were, as before, a choice between *Yes*, *No* or *Somewhat*.

Results of the comparison between the two datasets are summarised in Table XII.49 below.

Table XII.49 Comparison of Responses to Culture of Green ICT in UK and Irish Institutions.

Green ICT projects typical of your institution's culture	UK	Ireland
Yes	21 (51%)	6 (43%)
No	11 (27%)	3 (21.4%)
Neither typical nor non-typical.	9 (22%)	5 (35.7%)
Total	**41**	**14**

Analysis of Comparison of Responses to Culture of Green ICT.

For institutions in both the UK and Ireland, participating in green ICT projects is typical of their culture as the majority of responses, 51% (21) and 43% (6) respectively, indicates this. However, respondents from both countries also indicated that participating in green ICT projects was not typical of their institution's culture in similar amounts 27% and 21.4% respectively. Finally just as many respondents indicated it was neither typical nor not typical of their institution to participate in a sustainable ICT project. The lack of extreme data, 10% or less or 90% or more, for any single response indicates that green ICT is part of FHE institutions culture on both sides of the Irish Sea, albeit to a moderate extent.

Appendix XII.50 Comparison of Yes Responses to Culture of Green ICT.

UK and Irish respondents were asked to choose from two possible answer options regarding why they answered *Yes* to the question pertaining to experiencing a culture of Green ICT at their institutions'. Comparison of those results are summarised in Table XII.50.

Table XII.50 Comparison of *Yes* Responses to Culture of Green ICT in UK and Irish Institutions.

Yes to Green ICT projects typical of institution's culture	UK	Ireland
We have very innovative and proactive senior manager(s) who encourage participation in sustainable projects, green ICT or otherwise.	18 (86%)	4 (80%)
Our institution is a leader in ICT research with strong links to other research organisations so participating in a green ICT project is the norm.	3 (14.3%)	1 (20%)
Total	21	5

Analysis of Comparison of Yes Responses to Culture of Green ICT.

More than 80% of respondents from both countries stated that having an innovative and proactive senior managers, who encouraged participation green ICT projects, affected their institutions' culture towards utilising greener technologies. This was followed by fewer responses from institutions in both countries, whose managers indicated being sector leaders in ICT research with strong links to other research organisations. Participating in a green ICT project was in fact, not the norm. Results clearly indicate that regardless of the nationality of an institution, a passionate and proactive member of staff, who campaigns for greater engagement in environmentally sustainable projects, can affect cultural change and ultimately the carbon footprint of an institution.

Appendix XII.51 Comparison of No Responses to Culture of Green ICT.

UK and Irish respondents were who answered *No* to the question on institution culture, were then asked to choose from two possible answer options below, as to why they answered no. The comparison of both datasets are summarised in Table XII.51 below.

Table XII.51 Comparison of *No* Responses to Culture of Green ICT in UK and Irish Institutions.

No to Green ICT projects typical of institution's culture	UK	Ireland
My institutions senior manager(s) are not interested in participating in sustainable projects, green ICT or otherwise	8 (73%)	2 (100%)
Our institution is very traditional in the subjects it teaches and rarely deviated from them. (i.e. not very innovative or proactive when it comes to participating in anything new).	3 (27%)	0
Total	11	2

Analysis of Comparison of No Responses to Culture of Green ICT.

Respondents from both UK and Irish institutions indicated that green ICT was not part of their institutions' culture, because of a lack of interest on the part of their managers to participate in sustainable projects, green ICT or otherwise. Responses from UK institutions also indicated that failure on their part to deviate from teaching traditions was partially responsible for their institutions' not engaging with sustainable ICT projects, albeit it at a lower rate. However, in Ireland this was proven not to be the case, as none of the survey respondents chose this answer. This indicates that some Irish institutions have managers who are not interested in participating in sustainable ICT projects but are also not concerned about their institutions traditional teaching culture and did not regard this as a barrier.

Comparison of "Neither Typical nor Not Typical" Responses to Culture of Green ICT.

UK and Irish survey respondents were asked to leave a comment explaining why they answered *Neither Typical nor not Typical* when asked about Green ICT being part of their institutions' culture. The comments are listed below and the reader is invited to draw their own comparisons.

UK Responses

- Incorporating sustainability within IT requires collaboration between the Sustainability Team (in the Estates Division), and the IT Division. This means it's sometimes hard to align objectives, but there's general willingness to make progress. The challenges of the institution being siloed, and the enabling factors of people being willing to try to make something work, are both typical of the organisation.
- It varies across the organisation
- Running IT is not main business for a University and is largely a technical task so for the bulk of infrastructure work, IT professionals were left to get on with it and users were not engage. Where change impacted users, then there was proper involvement through projects and change management.
- Not aware of a change to greener ICT.
- Not sure that senior managers fully engage unless you play the cost savings card. However proactive at lower levels of management.
- Because I have no idea. We have a new head of IT, and there does not seem to be a clear typical anything right now.
- It happens as an unintended consequence of upgrading to newer equipment
- Because as with most things it depends on the part of the institution. There are some examples of good practice and lots of examples of bad!

Irish Responses.

- Some green projects are adopted, some are not
- Participating in initiatives such as these, normally requires an evangelist who will do most of the running. Once a given project is over then we tend to wait for another one to come along that captures somebody else's imagination to run with. it is not yet identified as sole responsibility of anyone to do this.
- It's not a priority focus and has not been on the main work list.

Analysis of Comparison of Neither Typical nor Not Typical Responses to Culture of Green ICT.

The responses above indicate a culture in both countries of disconnection, ambiguity and ambivalence to greener ICT. This is primarily due to poor leadership. Survey respondents from both countries indicated a degree of knowledge about the implementation of greener technologies and of which department should take charge, but also recognised it was the responsibility of senior managers and/or nominated staff to ensure carbon emission are reduced and projects are completed. However, as environmental sustainability, and therefore utilisation of greener technologies, are not considered part of university core business, participation in these projects are often sidelined. This results in they not being considered part of the culture and therefore not hugely promoted and communicated to stakeholders, further exacerbating ambivalent to poor stakeholder engagement as regards implementing greener ICT.

Appendix XII.52 Government Organisation as Drivers.

As both countries have different government organisations as drivers, it was not possible to make a like-for-like comparisons of the two datasets, so no comparison was made.

Comparison of Responses to Green Technology Delivering on Financial and Carbon Savings.

A comparison of UK and Irish responses to the question pertaining to green technology delivering on the financial and carbon savings promised by IT companies was made and is summarised in the Table XII.52.

Table XII.52 Comparison of Responses to Green Technology Delivering on Financial and Carbon Savings.

Green ICT technology delivers on the financial and carbon savings promised by IT companies?	UK	Ireland
Yes	6 (16%)	2 (17%)
No	6 (16%)	3 (25%)
Somewhat	25 (68%)	7 (58%)

Total	37	12

Analysis of Comparison of Responses to Green Technology Delivering on Financial and Carbon Savings.

There is a closeness in percentage of response rates from the UK and Irish institutions as regard believing that green technology delivers on the financial and carbon savings promised by IT companies, with 16% (6) of the UK and 17% (2) of the Irish survey respondents indicating this. Responses from both surveys also showed that the same amount, and more, of respondents did not feel that green technology delivered on the financial and carbon savings promised by IT companies. However, overwhelmingly both UK and Irish institutions indicated that green ICT technology only somewhat delivered on the financial and carbon savings promised by IT companies. Overall, the results indicated similarity between the two countries in each of their response rates.

Appendix XII.53 Comparison of Yes or Somewhat Responses to Green Technology Delivering on Financial and Carbon Savings.

A comparison between the combination of UK Yes and Somewhat responses and that of the Irish responses to the question on performance of green ICT, was made. The researcher decided to combine the Yes and Somewhat responses as they indicated a move towards implementation of greener technologies. Respondents were invited to choose more than one answer option, as institutions may have implemented more than one type of sustainable ICT initiative. Table XII.53 shows the list from which respondents were asked to choose which of the Green ICT initiatives were implemented in at their institutions and were invited to tick more than one if applicable

Table XII.53 Comparison of Green ICT Initiatives Implemented in UK and Irish Institutions

Green ICT Initiative	UK	Ireland

Automatic switch off/powerdown of PCs when not in use.	18	3
Automatic switch off/powerdown of PCs at 5pm/end of work day.	8	3
Print and Copy double sided by default	21	6
Virtulisation of servers	20	8
Cloud Computing	16	7
Installation of greener data centres	15	4
Switch to use of shared services	7	7
Switch to Thin Client Technology (servers, PCs etc.)	3	1
Switch to BYOD (Bring Your Own Device	4	1
Video Conferencing	15	7
Greener networks (switches, cables etc.)	6	2
Switch to MFDs (multifunctional devices) for printing, copying, scanning etc.	24	4
Introduction of "Hot-Desking" and "Hoteling"	6	1
Total Respondents	29	8

*****29 UK and 8 Irish respondents indicated which of the more sustainable technologies were implemented at their institution. Three Irish institutions implemented just one type of sustainable initiative, the rest implemented two or more, thus explaining the higher number of total responses from each country.

Analysis of Comparison of Yes and Somewhat Responses to Green Technology Delivering on Financial and Carbon Savings.

Where the UK is concerned switching to MFDs and printing and copying double-sided proved to be the most popular of the sustainable ICT initiatives. Virtualisation

of servers and cloud computing also proved popular, as did automatic power-down, installing green data centres and using video conferencing. Results are similar to that of the Irish survey, as these same technologies proved to be the most popular in Ireland too. This may be due to their having a less complicated installation process. The installation of MFDs, printing and copying double-sided by default, and video conferencing are readily available in both countries and are straightforward to install and use. While the installation of greener data centres, migration to cloud computing and the virtualisation of servers require much more resources to install and maintain, they have proven to save a significant amount of money. Technologies that did not score as well in both countries include automatic switch off at 5pm, use of shared services, switch to thin client technology use of greener networks and switches, BYOD and Hoteling and Hot-Desking. This is likely to be because they cause an interruption to services, undermine data security or are not a good fit for some institutions.

Appendix XII.54 Comparison of No Responses to Performance of Green ICT.

A comparison between the combination of UK No responses and that of the Irish responses to the question on performance of green ICT, was made. Respondents were invited to choose more than one option, as they may have had more than one reason for choosing not to implement greener technologies. Results of the comparison of responses are summarised in Table XII.54.

Table XII.54 Comparison of No Responses to Performance of Green ICT in UK and Irish Institutions.

Green ICT technology not delivering on the financial and carbon savings promised by IT companies?	UK	Ireland
Could not see a reduction in energy costs.	2 (20%)	0
Purchase costs far exceeded any savings made.	5 (50%)	3 (75%)
By the time R.O.I was realised, technology was out of date.	3 (30%)	1 (25%)
Total	10	4

Analysis of Comparison of No Responses to Green Technology Delivering on Financial and Carbon Savings.

For both countries, the purchase costs far exceeding any savings made was the main reason respondents decided that green technology did not deliver on the financial and carbon savings promised by IT companies. For UK respondents it was also because they could not see a reduction in energy costs and that by the time a return on investment (R.O.I) was realised, technology was out of date. However, only one Irish participant indicated this was the case. None of the Irish institutions indicated that not being able to see a reduction in energy costs was why they responded *No* whereas as two of the UK survey respondents indicated that this was the reason.

Appendix XII.55 Cuts in Funding

A comparison was made of the responses to the question on cuts in funding to establish if UK institutions were affected in the same way as those in Ireland were. While the cuts were not made by the same governments, their effects are likely to have been the same .i.e. job losses, reduction in number of projects funded or reduction in resources. Respondents were asked if cuts in funding affected their institutions' ability to participate in sustainable ICT projects and were given three answer option to choose from, *Yes*, *No* or *Somewhat*. A comparison of the responses to that question are summarised in Table XII.55.

Table XII.55 Comparison of Effects of Cuts in Funding of UK and Irish Institutions to participate in Sustainable ICT projects.

Response	UK	Ireland
Yes	10 (27%)	5 (45.5%)
No	17 (45%)	5 (45.5%)
Somewhat	10 (27%)	1 (9%)
Total	37	11

Analysis of Comparison of Responses to Cuts in Funding.

The majority of UK survey respondents, 45% (17) did not feel that cuts in funding affected their ability to participate in sustainable ICT projects. 27% (10) of respondents stated that it had or that it *Somewhat* had. Combined, these data indicated that cuts in funding affected institutions' ability to participate in sustainable ICT projects, which is contrary to the results of a preliminary survey carried out two years prior (Hogan, 2012). In contrast, results of the Irish survey indicated that as many respondents had their ability to participate in sustainable ICT projects affected by cuts in funding as those that did not. Only one Irish respondent indicated being *Somewhat* affected. This indicates that overall cuts in funding affects institutions' ability to participate in sustainable ICT projects to varying degrees in each country and can therefore be considered a barrier.

Appendix XII.56 Purchasing Framework.

A comparison of UK and Irish responses to the question pertaining to belonging to a purchasing framework was carried out to establish if any similarities or differences existed. A comparison of responses from UK and Irish institutions are summarised in Table XII.56.

Table XII.56 Comparison of responses from UK and Irish Institutions on belonging to a purchasing framework.

Being supported in choice to purchase sustainable technology.	**UK**	**Ireland**
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT	15 (42%)	2 (18%)
Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT	8 (22%)	1 (9%)
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT	2 (8%)	2 (18%)
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT	0	0

Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT	4 (11%)	1(9%)
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	6 (17%)	5 (45%)
Total	35	11

Analysis of Comparison of Responses to Purchasing Frameworks.

Results of both surveys were similar for some answers yet much different for others. The majority of respondents in the UK survey, 45% (15) indicated that their institutions were part of a framework and they felt supported in their decisions to purchase green ICT, whereas in Ireland only 18% (2) respondents indicated this. The second most populous answer from UK respondents was that their institution was part of a framework, but they still did not feel supported in their decisions to purchase green ICT, yet only one respondents in the Irish survey indicated this. Not being sure if their institution was part of a framework, and not feeling supported in their decisions to purchase green ICT was the third most common response in the UK survey and the most common response in the Irish survey. Only 11% (4) UK respondents indicated that they were not sure if they were part of a framework, but still felt supported in their decisions to purchase green ICT whereas only 9% (1) Irish respondent answered with this option choice. Two respondents from both the UK and the Irish survey (8% and 18% respectively) answered that their institutions' were not part of a framework but still felt supported in their decisions to purchase green ICT. Finally, neither UK nor Irish respondents indicated they were not part of a framework and did not feel supported in their decisions to purchase green ICT. This is the only answer option *not* chosen by either UK or Irish respondents indicating that at least frameworks of sorts appeared to be in place and that some level of support existed. Overall, responses to this question indicated a mixture of the presence and absence of purchasing frameworks in both UK and Irish institutions and within the absence or presence of a purchasing framework, feelings of both support and non-support from respondents existed.

Appendix XII.57 Lacking Managers.

A comparison of UK and Irish responses pertaining to the question on lacking ICT managers was made. Respondents were offered a choice of answer options and were invited to choose more than one answer option. This comparison was made to establish if there were similarities or disparities in responses. The responses are summarised in Table XII.57.

Table XII.57 A Comparison of Responses to Lacking ICT managers.

Lacking Managerial Characteristics	UK	Ireland
Poor knowledge of green ICT issues.	10 (12%)	0
Disinterest of green ICT issues.	12 (14.45%)	3 (12%)
Disinterest in "outside" green ICT projects (i.e participating not requested from senior management).	7 (8.4%)	2 (8%)
Is negatively influenced by institutional politics.	11 (13.25%)	3 (12%)
Is under-resourced in terms of funding for new technology.	10 (12%)	6 (24%)
Is under resourced in terms of allocation of support staff.	11(13.25%)	4 (16%)
Is under resourced in terms of allowances for staff training, upskilling, etc.	10 (12%)	4 (16%)
None of the above.	12 (14.45%)	3 (12%)
Total	83	25

Analysis of Comparison of Responses to Lacking Managers.

Poor knowledge of and disinterest in green ICT issues, being negatively influenced by institutional politics, being under-resourced in terms of funding for new technology, for allocation of support staff, for allowances for staff training and upskilling each scored approximately the same, i.e. between 12% and 14.45% in the UK survey. Only having a disinterest in "outside" green ICT projects scored lower. Surprisingly, a greater number of managers, more than 14% (12), indicated their ICT

managers exhibited none of the lacking characteristics. Results from the Irish survey differed, with none of the Irish survey respondents indicating that their ICT managers had a poor knowledge of green ICT issues. This is not surprising as the majority of respondents in the Irish survey were IT or ICT managers and they are not likely to admit being disinterested in ICT of any type. Results also showed that the remainder of the lacking characteristics were as common place as one another. Being under-resourced in terms of funding for new technology was the most common response to this question from Irish respondents and similar to the UK survey. Having a disinterest in "outside" green ICT projects was the least common response.

Summary of Comparison of Responses between UK and Irish Surveys.

Overall results of the UK and Irish survey indicated a mixture of both similar and differing results when examining barriers to participation in sustainable ICT projects. Some answers indicated a strong similarity between the two countries: such as belonging to purchasing frameworks where none of the respondents in either survey stated not being part of a framework and not feeling supported in decisions to purchase green ICT. Yet in other instances, they had opposite views on whether a barrier existed or not and to what extent. However, it is worth noting that as the majority of respondents in the Irish survey were ICT or IT managers, the results are likely to be biased towards demonstrating competency in the knowledge and use of sustainable technology. In conclusion each of the barriers existed in both countries to some extent.

Appendix XII.58 London Versus Rest of UK.

Introduction.

As more than half of the UK survey respondents were from universities in the London region, it was decided that a comparative analysis of responses from London institutions and those from across the rest of the UK should be carried out. This would establish if there were any similarities or disparities between both datasets. Responses from the Irish survey were not included in this analysis as they are not part of the UK.

The first question, which compared London and the Rest of the UK responses, pertained to respondents' job roles. Both datasets of responses are compared and summarised in Table XII.58.

Table XII.58 Comparison of London and Rest of UK Job Roles.

Job Role	London	Rest of the UK
ICT/IT Manager	2 (6.45%)	9 (31%)
Environmental/Sustainable Manager	8 (25%)	7 (24.13%)
Energy Manager	2 (6.45%)	1 (3.44%)
Space Manager	0	0
Estates and Facilities Manager	1 (3.25%)	1(3.44%)
Procurement/Finance Manager	2 (6.45%)	0
Carbon Manager	0	0
Utilities Manager	0	1(3.44%)
Other	16 (52%)	10 (34.5%)
Total	31	29

Analysis of Role at Institutions by London Versus Rest of UK Responses.

Of the managers from London institutions that took part in the UK survey, more than half (52%) categorised themselves as Other managers. A quarter of them (25%) were Environmental/Sustainable Managers. ICT/IT Managers, Energy Managers and Procurement/Finance Manager participated in equal amounts of 6.45% (2). Just one Estates and Facilities manager from a London institution participated and no Utility, Carbon or Space managers participated in the survey. Similarly, Other managers from institutions across the Rest of the UK made up the majority of

respondents 34.5%, (10) with 24.13% (7) of respondents being Environmental/Sustainable Managers and just 31% (9) of ICT/IT managers from the Rest of the UK participating. Similar to respondents from London institutions, Carbon managers and Space managers did not participate and only one Estates and Facilities Manager participated. However, unlike London institutions, a Utilities manager participated but Procurement nor Finance managers did not. The largest difference between the London and rest of UK respondents was the percentage of ICT managers who responded to the survey. 31% (9) of responses from institutions across the Rest of the UK came from ICT/IT managers, in comparison to London where ICT/IT managers made up less than 7% of total respondents. Overall, Other managers made up the bulk of survey respondents, but as this category of managers consists of a mixture of administrative staff, senior management, academic staff and students, it offered a balanced approach to the research.

Appendix XII.59 Comparison of Length of Time in Current Role.

A comparison of the London and Rest of the UK responses to the question pertaining to the length of time in current job is summarised in Table XXI.59 below. This establishes any disparity or similarity between the two datasets.

Table XXI.59 Comparison of London and Rest of UK Responses to Length of time in Job Role

Length of time in Job Role	London	Rest of the UK
0-5 years	19 (63.33%)	14 (46.67%)
6-10 years	6 (20%)	9 (30%)
11-15 years	1 (3.1%)	3 (10%)
16-20 years	3 (10%)	1 (3.1%)
21-25 years	0	2 (6.67)
26-30 years	1 (3.1%)	1(3.33%)
Total	30	30

Analysis of Comparison of London and Rest of the UK Responses to Length of Time in Job Roles.

Results are somewhat similar in that the majority of managers from both regions of the UK have been in their roles for five years or less with the number of survey respondents decreasing as the length of time in their roles increased. The only exception to this is a slight increase for respondents in London institutions who indicated being in their roles between sixteen to twenty years, then none of them worked between twenty-one and twenty-five years and just 3.1% of respondents (1) indicated working twenty-six to thirty years.
A similar exception occurred with respondents in the Rest of the UK who experienced a slight increase (or doubling) in the number of respondents who were in their roles between twenty-one and twenty-five-25 years. Overall results indicate an experienced workforce with the majority of respondents from both regions having up to fifteen years' experience in their roles.

Appendix XII.60 Comparison of Length of time working in the University and College sector.

A comparison between the London and Rest of the UK respondents regarding the length of time working in the FHE sector was made and summarised in Table XII.60 below. This was to establish and similarity or disparity between the two datasets.

Table XII.60 Number of years in the university and college sector.

Number of years in the university and college sector.	London	Rest of UK
0-5 years	12 (40%)	8 (27%)
6-10 years	8 (27%)	6 (20%)
11-15 years	5 (17%)	8 (27%)
16-20 years	1 (3%)	3 (10%)
21-25 years	2 (6%)	3 (10%)
26-30 years	2 (6%)	2 (6%)

Total	**30**	**30**

Analysis of Comparison of Responses to Number of Years University and College Sector.

Responses from London and the Rest of the UK institutions did not follow a similar pattern as in the previous question. Instead both regions had a mixture of increases and decreases in the number of respondents as the number of years in the sector increased. On average however, the numbers of respondents decreased as the number of years worked in the sector increased for institutions in both UK regions. This gave an overall uneven distribution of input from experienced sector veterans to the research.

Appendix XII.61 Stakeholder Engagement.

Responses from both datasets relating to the question on stakeholder engagement were compared to establish any disparity or similarity. Respondents were asked “when implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged i.e. willing to adjust to changes in job roles, train in the use of greener technologies?”. A summary of the comparison of those results is included in Table XII.61 below.

Table XII.61 Comparison of Stakeholder Engagement in Green ICT Projects UK and Irish Institutions.

Stakeholder Engagement.	London	Rest of the UK
Yes	7 (32%)	11 (41%)
No	5 (22.72%)	1 (3.7%)
Neither Engaged nor Disengaged	10 (45.45%)	15 (55.55%)
We have not tried to implement greener ICT in our institution.	0	0
Total	22	27

Analysis of Comparison of Responses to Stakeholder Engagement.

Results indicated a greater level of engagement in institutions outside of London as 41% (11) of Rest of UK FHE managers stated they were engaged and only 3.7% (1) stated that stakeholders were not engaged. For London institutions, the numbers were a bit closer, with 32% (7) stating they were engaged and 22.72% (5) stating their stakeholders were not engaged. However, numbers were higher for the *Neither Engaged nor Disengaged* answer option for both groups of regions of the UK, with 45.45% (10) London FHE managers and 55.55% (15) Rest of the UK FHE managers answering this option. Respondents in both groups had at least tried to implement greener ICT in their institution, as nobody chose the answer option of not having tried to implement greener ICT in their institution. Greater engagement in sustainable ICT projects for institutions outside London might indicate a cultural issue, as well as institutions being smaller in some instances and therefore more manageable with a greater sense of community.

Appendix XII.62 Comparison of *Yes* Responses to Stakeholder Engagement.

Respondents who answered *Yes* to Stakeholder Engagement were then asked to choose from four answer options indicating why they chose that answer option. The researcher then decided to compare the *Yes* responses from London and the Rest of the UK Institutions. Results of those responses are summarised in Table XII.62 below.

Table XII.62 Comparison of *Yes* Responses to Stakeholder Engagement in UK and Irish Institutions.

Yes to Stakeholder Engagement.	London	Rest of the UK
Stakeholders were informed of the reason(s) why the switch to greener technology was being made and felt included in the decision-making process.	5 (38.46%)	7 (36.84%)
Older technologies were starting to slow down/fail so stakeholders welcomed newer, faster ICT equipment.	4 (31%)	4 (21%)
Stakeholders supported any initiative that reduced energy bills and carbon emissions.	4 (31%)	7 (36.84%)
Total	13	19

*****SurveyMonkey reads 9 responses in total for answer option 2, but calculated individual responses indicate only 8 respondents answered this option. This is likely due to a respondent changing their mind regarding a response but SurveyMonkey failed to make the change.

Analysis of Comparison of *Yes* Responses to Stakeholder Engagement.

Overall, each of the answer options given as possible reasons for stakeholder engagement were chosen by both London respondents and those in the Rest of the UK, in almost equal amounts. Being included in the decision-making process to switch to greener ICT as well as stakeholders generally supporting any initiative that reduces energy bills and carbon emissions, were the main reasons stakeholders were engaged. Older technologies slowing down or failing was also a reason, but not to the same extent. London respondents indicated that stakeholders were engaged as they chose each of the answer options in almost equal amounts of between 31% (4) to 38.46% (5). However, survey responses from respondents in institutions in the Rest of the UK, were more varied with response rates varying between 21%(4) and almost 37%(7). Overall, responses indicate a balanced approach to stakeholder engagement in sustainable ICT projects regardless of geographical location of institutions. Results also indicated the holistic and engaging mindset of stakeholders in institutions across the UK when being asked to engage with the use of more sustainable technologies in the workplace.

Appendix XII.63 Comparison of Neither Engaged nor Disengaged Responses.

One of the answer options to the question on stakeholder engagement was being *Neither Engaged nor Disengaged*. The researcher chose to compare the two datasets to establish if any disparity or similarity between respondents from the two UK regions existed. Those comparisons are summarised in Table XII.63.

Table XII.63. Reasons for London and Rest of UK institutions being Neither Engaged nor Disengaged with Green ICT.

Neither Engaged nor Disengaged to Stakeholder Engagement.	**London**	**Rest of the UK**
Stakeholders were not informed of the changes to greener ICT, they happened gradually over the course of the year(s).	3 (33%)	7 (46.6%)

Stakeholders didn't really have an opinion on the switch to greener technology, some protested, some were vocal supporters, most said nothing.	6 (66%)	8 (53.3%)
Total	9	15

* Total number of responses is 24 but SurveyMonkey indicated only 23 respondents answered this question. This is because one respondents answered the question twice.

Analysis of Comparison of Neither Engaged nor Disengaged Responses.

Responses to these answer options differed between the two regions, albeit on a minimal level. Respondents from the Rest of the UK institutions indicated a complacent approach to green ICT initiatives as the majority of the participants 53% (8) answered that their stakeholders did not really have an opinion on the switch to greener technology, some protested, some were vocal supporters, while most said nothing. Almost the same amount, 46.6% (7) stated that stakeholders were not informed of the changes to greener ICT, they happened gradually over the course of the years. 33% (3) and 66% (6) of London respondents answered at the same rate respectively. Although at a 33% response rate in comparison to a 66% response rate, results indicated that half the amount of stakeholders complacency was as a result of not being informed of changes to greener ICT instead allowing them to happen gradually over the course of the year(s). This appears to be the best technique when implementing greener ICT initiatives, regardless of institutions' geographical region in the UK.

Appendix XII.64 Comparison of *No* Responses to Stakeholder Engagement.

A similar comparison was made with the *No* responses to the question on stakeholder engagement. Survey respondents were given four answer options and invited to choose more than one answer option. Those responses are summarised in Table XII.64 below.

Table XII.64 Comparison of *No* Responses to Stakeholder Engagement in London and Rest of the UK Institutions.

No to Stakeholder Engagement.	London	Rest of the UK
Switching to greener ICT resulted in disruption to services.	0	0
Stakeholders did not like having to adjust to green ICT initiatives such as printing and copying double sided, communicating electronically instead of using paper etc.	0	0
Switching to greener ICT required behavioural change such as Printing and Copying double sided or eliminating paper use where possible, communicating using technology as oppose to travelling long distances, sharing user services as opposed to exclusive ownership of technologies and equipment etc.	2 (50%)	0
Stakeholders expressed their lack of confidence in "green ICT" i.e. new technology is not very green.	2 (50%)	1 (100%)
Total	4	1

Analysis of Comparison of No Responses to Stakeholder Engagement. The amount of responses to this question were similar in some respects and opposite in others. Respondents from London institutions and from institutions in the Rest of the UK did not think that switching to greener ICT resulted in disruptions to services or that stakeholders did not like having to adjust to green ICT initiatives, as both answer options scored zero. Instead, respondents from London institutions indicated that lack of engagement of stakeholders was caused by the requirement of behavioural change and that stakeholders were not confident in the savings offered by green ICT, as 50% (2) respondents chose this answer option. While 100% (1) of respondents from institutions in the Rest of the UK also indicated a lack of confidence in "green ICT" was a barrier, they did not indicate that that behavioural change was also one.

Appendix XII.65 Culture of Green ICT.

A comparison was made between the London and Rest of the UK responses to the question relating to having a culture of green ICT at their respective institutions. Respondents were asked if “participating in green ICT projects was typical of your institution's culture?” and given three possible answer options, - *Yes*, *No* or *Somewhat*.

The responses are summarised in Table XII.65

Table XII.65 Comparison of Responses to Culture of Green ICT in London and Rest of UK Institutions.

Green ICT projects typical of your institution's culture	London	Rest of the UK
Yes	9 (53%)	12 (50%)
No	3 (17.64%)	8 (33.33%)
Neither typical or non-typical	5 (29.41%)	4 (16.66%)
Total	17	24

Analysis of Comparison of Responses to Culture of Green ICT.

Respondents from both London institutions and institution from The Rest of the UK answered *Yes*, *No* and *Neither typical or non-typical* when asked about their institution’s culture in varying amounts. Similarly, 53% (9) of respondents from London institutions and 50% (12) of respondents from institutions in the Rest of the UK indicated that participating in green ICT projects was typical of their institution's culture. 17.64% (3) of London respondents and more than 33% (8) of the Rest of the UK respondents indicated it was not part of their culture. Almost 30% (5) of respondents from London institutions and 16.66% (4) from Rest of the UK institutions indicated that participating in green ICT projects was *neither typical nor not typical* of their institution's culture. Overall results indicated a mixture of responses regarding green ICT being part of an institution’s culture. However, there is a slight lean towards it being part of the culture in both London and the Rest of the UK institutions. If *Yes* and *Neither Engaged nor Disengaged* responses from both datsets are combined, 82.41% (14) of London institutions have a culture of

green ICT. Similarly, where the Rest of the UK respondents are concerned a total of 66.66% (16) of respondents indicated that green ICT was part of their culture. Only 17.64 % (3) of respondents from London institutions and 33.33% (8) of respondents from the Rest of the UK institutions stated that green ICT was not part of their culture.

Appendix XII.66 Comparison of Yes Responses to Culture of Green ICT.

London and the Rest of UK respondents were asked to choose from two possible answer options regarding why they answered *Yes* to the question pertaining to having a culture of Green ICT at their institution and were invited to choose both options is applicable . A comparison of those results are summarised in Table XII.66.

Table XII.66.Comparison of Responses to Culture of Green ICT in London and Rest of UK Institutions.

Yes to Green ICT projects typical of institution's culture	London	Rest of the UK
We have very innovative and proactive senior manager(s) who encourage participation in sustainable projects, green ICT or otherwise.	8 (100%)	10 (77%)
Our institution is a leader in ICT research with strong links to other research organisations so participating in a green ICT project is the norm.	0	3 (23.07%)
Total	8	13

Analysis of Comparison of Yes Responses to Culture of Green ICT.

Having a very innovative and proactive senior manager who encouraged participation in sustainable ICT projects was the most popular reason given for choosing *Yes* when asked about ICT culture in their institution for both London and the Rest of the UK respondents. In fact for London respondents, it was the only reason. London respondents did not consider their institutions to be a leader in ICT research with strong links to other research organisations, nor did approximately 77% of respondents from institutions across the Rest of the UK.

Appendix XII.67 Comparison of No Responses to Culture of Green ICT.

Respondents who answered *No* to the question on institutional culture, were asked to choose from two possible answer options regarding why they answered *No*. Responses from both groups of respondents are summarised in the Table XII.67.

Table XII.67 Comparison of *No* Responses to Culture of Green ICT in London and UK Institutions.

***No* to Green ICT projects typical of institution's culture**	**London**	**Rest of the UK**
My institution's senior manager(s) are not interested in participating in sustainable projects, green ICT or otherwise	2 (50%)	6 (85.71%)
Our institution is very traditional in the subjects it teaches and rarely deviated from them. (i.e. not very innovative or proactive when it comes to participating in anything new).	2 (50%)	1(14.28%)
Total	4	7

Analysis of Comparison of No Responses to Culture of Green ICT.

Both London and the rest of the UK respondents indicated that their senior managers were not interested in participating in sustainable ICT projects and that their institutions' were traditional in the subjects that they taught and rarely deviated from them. London respondents answered this question in even amounts, but for institutions from the Rest of the UK, they were less even. For the majority of institutions in the Rest of the UK, a disinterest by senior managers in green ICT was indicated as being the main reason why green ICT was not part of their institutions' culture. Only one institution answered that it was because of their culture of teaching of traditional subjects only. This indicates that for institutions in both regions but primarily for those in the Rest of the UK, having passionate and forward thinking managers is key to success and not having one can be considered a barrier.

Appendix XII.68 Comparison of "Neither typical nor not typical", Responses to Culture of Green ICT.

London and the Rest of UK survey respondents were asked to leave a comment explaining why they had answered *neither typical nor not typical* when asked about Green ICT being part of their institutions' culture. The comments are listed below in Table XII.68 from which comparisons can be inferred.

Table XII.68 Summary of Comments regarding Culture of Green ICT from Respondents from London and the Rest of the UK institutions.

London

- "Incorporating sustainability within IT requires collaboration between the Sustainability Team (in the Estates Division), and the IT Division. This means it is sometimes hard to align objectives, but there is general willingness to make progress. The challenges of the institution being siloed, and the enabling factors of people being willing to try to make something work, are both typical of the organisation".
- "Not aware of a change to greener ICT"
- "Because I have no idea. We have a new head of IT, and there does not seem to be a clear typical anything right now".
- "It happens as an unintended consequence of upgrading to newer equipment"

Rest of UK

- "It varies across the organisation"
- "Running IT is not main business for a University and is largely a technical task so for the bulk of infrastructure work, IT professionals were left to get on with it and users were not engage. Where change impacted users, then there was proper involvement through projects and change management".
- "Not sure that senior managers fully engage unless you play the cost savings card. However proactive at lower levels of management".
- "Because as with most things it depends on the part of the institution. There are some examples of good practice and lots of examples of bad".

Comparison of "Neither Typical nor Not Typical" Responses Culture of Green ICT.

Responses from managers in both the London and the Rest of the UK institutions indicated a similarity in the variation of levels of engagement with stakeholders. Managers from both London and Rest of the UK institutions indicated that implementing sustainable ICT initiatives was ad hoc and sporadic within their institution, required the participation of various departments to affect change and often only occurred with the agreement of senior management in an effort to reduce running costs. Overall, responses to neither typical nor not typical of green ICT being part of the culture was supported by their comments and is evidence of institutional culture being a barrier.

Appendix XII.69 Government Organisation as Drivers.

Respondents were asked to choose from six possible answer choices, ranging from excellent driver to very poor driver, their opinion on UK government organisations as drivers for green ICT projects. This was to establish if respondents from London institutions had the same experience as those from institutions across the Rest of the UK. A comparison of responses is given for each of the organisations in Table XII.69.

Table XII.69 Comparison of Responses from London and Rest of UK Institutions regarding Government Organisation as Drivers.

HEFCE	Excellent Driver	Very Good Driver	Good Driver	Neither Good Nor Bad Driver	Poor Driver	Very Poor Driver
London	1	0	5	5	1	0
Rest of the UK	5	0	8	6	2	0
DEFRA	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**

London	0	0	2	8	3	0
Rest of the UK	1	0	4	13	2	1
DECC	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	1	0	3	8	2	0
Rest of the UK	2	0	3	12	3	1
Salix	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	0	0	5	7	1	0
Rest of the UK	5	0	4	8	4	0
Local Authority	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
London	0	0	1	7	3	1
Rest of the UK	1	0	2	11	4	1

Other	Excellent Driver	Very Good Driver	Good Driver	Neither Good Nor Bad Driver	Poor Driver	Very Poor Driver
London	0	0	1	8	3	0
Rest of the UK	1	0	2	14	1	0

Analysis of Comparison of Responses to Government Organisations as Drivers.

Responses from managers in both London and The Rest of the UK institutions indicated a mixture of results when examining UK government organisations that support FHE institutions as drivers for participating in green ICT projects. The majority of organisations only scored “in the middle” when being considered as a driver for green ICT. Only HEFCE and The DECC were considered to be excellent drivers by respondents from London institutions, whereas each of the organisations listed were considered to be excellent drivers by at least one respondent from an institution in the Rest of the UK. Supporting this positive feedback, none of the government organisations was considered to be very poor drivers by any of the respondents from either London or Rest of the UK institutions, except for one respondent who indicated that Local Authorities were. Strangely, none of the government organisations was considered to be very good drivers by respondents in either London or the Rest of UK institutions either. The category of *Neither Good nor Bad Drivers* scored the highest results from respondents in both London and the Rest of the UK institutions indicating a weakness in government organisations to act as drivers to affect participation in green ICT projects and thereby reduce carbon emission. Each of the organisations listed were considered to be poor drivers by both London and the Rest of the UK institutions. Only Local Authorities, DEFRA and the DECC scored very poor drivers.

Appendix XII.70 Performance of Green ICT.

A comparison between the responses from the London and Rest of UK Institutions was made in relation to the performance of green technology in delivering on the

financial and carbon savings promised by IT companies. This comparison would establish any similarity or differences in opinions between respondents from both regions. The results are summarised in Table XII.70.

Table XII.70 Comparison of Responses from London and Rest of UK Institutions pertaining to Performance of Green ICT.

Green technology delivering on the financial and carbon savings promised by IT companies?	London	Rest of the UK
Yes	1 (6.66%)	5 (22.7%)
No	2 (13.33%)	4 (18.18%)
Somewhat	12 (80%)	13 (59.09%)
Total	15	22

Analysis of Comparison of Responses to Performance of Green.

Results indicated that green ICTs reputation as a cost and carbon saver amongst London institutions was very low with less than 7% (1) indicating that it was and 80% stating that it *Somewhat* was. More than 13% stated it was not. Similarly, 22% (5) of respondents in institutions from the Rest of the UK indicated that green ICT delivered on cost and carbon savings and almost 60% (13) of respondents indicating that it only *Somewhat* did. More than 13% (2) of respondents from institutions in London and more than 18% (4) of respondents from institutions in the Rest of the UK stated they did not believe in the savings offered. As previously, respondents who answered *Yes* or *Somewhat* to the question on performance of green ICT, were asked to choose from a list of green ICT initiatives implemented at their institution and were also invited to choose more than one where applicable. Responses would give an indication of the popularity of the greener technologies and thereby offer further insight into why respondents answered *Yes* or *Somewhat* to the previous question. Those responses from London and the Rest of the UK respondents were then compared. These comparisons are shown in Table XII.71

Table XII.71 Comparison of Green ICT Initiatives Implemented by London and rest of UK Institutions.

Green ICT Initiatives	London	Rest of the UK
Automatic switch off/powerdown of PCs when not in use.	7	15
Automatic switch off/powerdown of PCs at 5pm/end of work day.	3	5
Print and Copy double sided by default	9	12
Cloud Computing	5	11
Installation of greener data centres	4	11
Switch to use of shared services	4	3
Switch to Thin Client Technology (servers, PCs etc.)	1	2
Switch to BYOD (Bring Your Own Device)	0	4
Video Conferencing	4	11
Greener networks (switches, cables etc.)	1	5
Switch to MFD's (multifunctional devices) for printing, copying, scanning etc.	9	15
Introduction of "Hot-Desking" and "Hoteling" (reserving a hot-desk).	3	3
Total	50	97

Appendix XII.71 Analysis of Comparison of Responses from London and Rest of UK institutions on Performance of Green ICT.

Managers from both London and the Rest of the UK institutions implemented each of the technologies listed, with the exception of London institutions, which indicated not inviting students to bring their own devices. Automatic switch off or powerdown of PCs when not in use and switch to MFDs (multifunctional devices) proved most popular with institutions in the Rest of the UK. Results were similar from respondents from London institutions who indicated having implemented printing and copy double-sided by default. Cloud computing and the installation of greener data centres along with video conferencing were also popular initiatives in both parts of the UK and to a lesser extent "Hot-Desking" and "Hoteling" and switching to thin client technology. Using greener networks for savings was favoured by at least five survey respondents in institutions in the rest of the UK whereas as only one London participant favoured it. Overall a range of sustainable ICT initiatives were implemented in institutions across the UK. This represented the holistic approach recommended by the JISC Greening of ICT Programme manager and the SUS-TECH project manager when attempting to reduce ICT running costs and carbon emissions.

Appendix XII.72 *No* Responses to Performance of Green ICT.

Comparisons of responses between London and Rest of the UK institutions were made in relation to the No answers to performance of green ICT to establish and similarity or differences between the two datasets. A summary of comparisons of those datasets are summarised in Table XII.72.

Table XII.72 Comparison of No Responses from London and Rest of UK Institutions relating to Performance of Green ICT.

No Responses to Performance of green ICT.	London	Rest of the UK
Could not see a reduction in energy costs	0	2 (22.22%)
Purchase costs far exceeded any savings made	1 (100%)	4 (44.44%)

By the time R.O.I was realised, technology was out of date.	0	3 (33.33%)
Total	1	9

Analysis of Comparison of No Responses to Performance of Green ICT.

Responses from managers in London and the Rest of the UK institutions varied. None of the London managers indicated that they could not see a reduction in energy costs or that by the time R.O.I was realised, technology was out of date and only one manager (100%) indicated that costs far exceeded any savings made. These results indicated sector confidence in the ability of greener technologies to create cost and carbon savings. However, managers in institutions in the rest of the UK indicated otherwise. 22% (2) of respondents indicated they could not see a reduction in energy costs, 45% (4) indicated that purchase costs far exceeded any savings made and 33% (3) managers indicated that by the time R.O.I was realised, technology was out of date. Overall, only ten managers out of sixty indicated not believing that green ICT delivered in cost and carbon savings, demonstrating support from the sector in the cost and carbon savings afforded through the use of more sustainable technology.

Appendix XII.73 Comparison of Responses to Cuts in Funding.

This comparison was made to establish any similarities or disparities between responses from London institutions and those in the Rest of the UK regarding effects of cuts in funding to their institution. Respondents were asked to choose between answer option *Yes, No or Somewhat* and a comparison of those results is summarised in Table XII.73.

Table XII.73. Comparison of Responses from London and Rest of UK Institutions to question pertaining to Cuts in Funding.

Affected by Cuts in Funding.	London	Rest of the UK
Yes	3 (21.42%)	7 (30.43%)

No	7 (50%)	10 (43.47%)
Somewhat	4 (28.57%)	6 (26%)
Total	14	23

Analysis of Comparison of Responses to Cuts in Funding.

Responses indicated a similarity in results from both London and the Rest of the UK institutions. Respondents from both datasets answered *Yes*, *No* and *Somewhat* in similar amounts with no significant disparity in responses. The majority of respondents from both geographical regions indicated their institutions were not affected by cuts in funding. 21.42% (3) and 30.43% (7) of respondents from London and the Rest of the UK respectively answered *Yes* to being affected to cuts in funding. 29% (4) managers from London institutions and 26% (6) from the Rest of the UK answered *Somewhat*. Adding the *Yes* and *Somewhat* percentages together, almost half of London institutions (50%) and more than half of institutions from the Rest of the UK (56.43%) indicated being affected to some degree. This indicated that cuts in funding was a barrier to institutions regardless of geographical location. However, overall results also indicated that cuts in funding did not affect other institutions and these results mirror the results of a preliminary survey carried out in 2012, (Hogan, 2012). That survey concluded that cuts in funding inhibited sustainable projects from progressing in some institutions, whereas other institutions saw it as opportunity to operate even more sustainably.

Appendix XII.74 Comparison of Purchasing Framework Membership.

A comparison of responses to the question pertaining to membership of a purchasing framework between London and the Rest of UK institutions was carried out to establish if respondents from both geographical regions of the UK had the same experiences.
Each of the five possible answer options from both datasets were compared and are summarised in the Table XII.74.

Table XII.74 Comparison of Responses pertaining to Membership of a Purchasing Framework from London and Rest of UK Institution.

Part of a Purchasing Framework	London	Rest of the UK
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT.	4 (30.76%)	11 (50%)
Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT.	4 (30.76%)	4 (18.18%)
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT.	1 (7.69%)	1 (4.54%)
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT.	0	0
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	1(7.69%)	3 (13.63%)
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	3 (23.07%)	3 (13.63%)
Total	13	22

Analysis of Comparison of Responses to Purchasing Frameworks.

Respondents were given six answer options indicating whether they were or were not part of a framework and if they felt supported or not in their decision to purchase green ICT. Results showed that most institutions belonged to a purchasing framework of sorts, as only two survey respondents, one from a London institution, the other from an institution outside of London, stated they were not part of a framework. However, they both indicated feeling supported in their decisions to purchase green ICT. A total of ten institutions indicated being unsure of whether they belonged to a framework or not, despite four respondents still feeling supported in their green ICT purchasing decisions, with six managers in total not feeling supported. 30.76% (4) London institutions and 50% (11) Rest of the UK institutions indicated being part of a framework and feeling supported in green ICT purchasing

decisions, yet 30.76%(4) and 18.18%(4) managers in both London and the Rest of the UK institutions respectively, indicated not feeling supported. Overall, results indicated a mixture of both knowledge and lack of knowledge of institutional membership with purchasing frameworks, resulting in mixed feelings of support decisions to purchase greener technologies. This is a barrier for those wanting to purchase greener technologies but feeling unsupported in doing so.

Appendix XII.75 Lacking Managers.

A comparison between the responses from London and the Rest of the UK institutions regarding lacking ICT managers were made to establish if there were any similarities between responses from institutions in London and those in the rest of the UK. The researcher decided to investigate various aspects of a manager's role to establish possible reasons why they appeared to be lacking. Survey respondents were asked to choose from eight answer options, to describe lacking characteristics of their institution's ICT managers, and were invited to choose more than one answer option where applicable. The options included poor knowledge of green ICT issues, a disinterest in green ICT initiatives, disinterest in "outside" green ICT projects being negatively influenced by institutional politics, being under-resourced in terms of funding for new technology, being under resourced in terms of allocation of support staff, being under resourced in terms of allowances for staff training upskilling, and finally, none of the above. Responses were compared and are summarised in Table XII.75.

Table XII.75 Comparison of Responses Pertaining to Lacking Managers in London and Rest of UK Institutions.

Characteristics of Lacking Managers.	London	Rest of the UK
Poor knowledge of green ICT issues.	3 (13.63%)	7 (14.28%)
Disinterest in green ICT initiatives.	3(13.63%)	9 (18.36%)
Disinterest in "outside" green ICT projects (i.e. participating not requested from senior management).	2 (9%)	5 (10.20%)
Is negatively influenced by institutional politics.	4 (18.18%)	7 (14.28%)

Is under-resourced in terms of funding for new technology.	3(13.63%)	7 (14.28%)
Is under resourced in terms of allocation of support staff.	4(18.18%)	7 (14.28%)
Is under resourced in terms of allowances for staff training upskilling, etc.	3(13.63%)	7 (14.28%)
None of the above.	5 (22.72%)	7 (14.28%)
Total Number of Lacking Characteristics.	22	49

Analysis of Comparison of Responses to Lacking Managers. Results were mixed with twenty-two London respondents and forty-nine Rest of the UK respondents indicating that ICT managers at their institutions exhibited each of the lacking characteristics. However, 22.72% (5) of London respondents and 14.28% (7) of respondents from the Rest of the UK indicated that ICT managers at their institutions exhibited none of the lacking characteristics. The most prevalent lacking characteristic from respondents from institutions in the Rest of the UK was disinterest in green ICT initiatives with 18.36% (9) respondents choosing this answer option. However, only 13.63% (3) London respondents choose this answer. The lacking characteristics that received the lowest response rate from both London and Rest of UK institutions was ICT managers being disinterested in outside green ICT projects with approximately 10% of survey respondents choosing that answer option. The remainder of responses were evenly distributed especially from the Rest of the UK managers where respondents answered almost all of the remaining questions at the same rate of 14.28% (7). Responses from London institutions to the remainder answer options were between 13% (3) and 23% (5). Overall ICT managers in institutions across the UK are lacking and this appears to be a barrier. However, responses also indicated that much of the barriers appear to be outside of their control, as being negatively influenced by institutional politics, being under-resourced in terms of funding for new technology, allocation of support staff, and allowances for staff training and upskilling, is primarily due to institutional funding and how it is allocated by senior management. Three of the answer options: poor knowledge of green ICT issues, disinterest in green ICT initiatives, "outside" or as an in-house cost and carbon reducing initiative, have also proven to be barriers.

However, these can be controlled and improved through the input of more enthusiastic, passionate and innovative ICT/IT managers.

Conclusion of Comparison of Responses from London and Rest of the UK Institutions.

Overall the survey has evidenced how London institutions appear to be more sustainably-minded and appear to take action where practicable. This may be due to the researcher being part of the London Universities' Environmental Group (LUEG) and as such the level of support appears to have facilitated managers in their ability to do their job. This is evidenced in the disparity in replies from respondents in London institutions and their cohorts in institutions across the UK. Similarly, many of the barriers are experienced to the same extent, regardless of regional location. Survey respondents in various roles expressed the same opinion regarding management at their institution, its leadership and how they were tackling carbon emissions and reducing running costs. There appears to be a strong sense of community within the London Universities and this was evidenced in the number of responses to the survey.

Appendix XII.76 Comparison of Job Roles

Introduction

This section of the chapter examines and compares the response from ICT/IT managers, Environmental and Sustainability managers and respondents that categorised their job roles in the category of Other manager. In order to get a better idea of the mind-set of ICT or IT managers, Environmental and Sustainability managers and Other managers, the results of both the UK and the Irish Survey were combined. This allowed the researcher to examine and compare the responses of a total of twenty-one ICT or IT managers, fifteen Environmental or Sustainability managers and thirty Other managers. The researcher decided to omit Energy Managers, Space Managers, Estates and Facilities Managers, Procurement or Finance Managers, Carbon Managers and Utilities Managers from this analysis as their numbers were either too low or at zero. Their input is, however, summarised at the end of this chapter. Finally, the researcher chose the responses of only a selection of questions from both surveys, as it was decided that only these questions were relevant to establishing if the barriers existed or not

and to what extent. Results of the comparison of three job roles are summarised in Table XII.76.

Table XII.76. Comparison of Number of Respondents in Job Roles.

Total Number of ICT/IT Managers	Total Number of Environmental/ Sustainable Managers	Total Number of Other Managers
21	15	30

Appendix XII.77 Stakeholder Engagement.

A comparison of responses from each of the three types of managers was made regarding stakeholder engagement at their respective institutions. Each survey respondent was asked “When implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged i.e. were they willing to adjust to changes in job roles, train in the use of greener technologies etc.?” Their responses are summarised in Table X.II.77

Table X.II.77 Comparison of Responses from ICT/IT, Environmental/Sustainability Manager and Other Managers regarding Stakeholder Engagement in ICT projects.

Job Role	**Yes**	**No**	**Neither Engaged nor Disengaged**
ICT/IT Manager (21)	43% (9)	10 %(2)	48%(10)
Environmental/ Sustainability Manager (15)	40%(6) *	13.33%(2)	26% (4)
Other (30)	27 % (8)	10% (3)	43% (13)

Env/Sust. managers did not participate in the Irish survey

Analysis of Comparison of Responses to Stakeholder Engagement.

Less than 80% of Environmental/Sustainability respondents and only 80% of Other respondents answered the questions relating to stakeholder engagement, whereas

100% of ICT/IT respondents answered this question. 43% (9) of ICT/IT Managers and 40% (6) Environmental/Sustainability managers answered *Yes* when asked if stakeholders at their institution were engaged or not. Just 27% (8) of Other managers answered the same. 10% (2) of ICT/IT managers answered *No* when asked the same question, as did 13% (2) of Environmental or Sustainable managers and 10% (3) of Other managers. 48% (10) of ICT/IT Managers, 26% (4) of Environmental/Sustainability managers and 43% (13) of Other managers indicated stakeholders at their institutions were neither engaged nor disengaged. The same number of ICT/IT Managers and Environmental/Sustainability managers answered at the same response percentage, with no more than a 3% difference between them for either *Yes* or *No* answers regarding stakeholder engagement. However, the disparity in the percentage response rate to the *Neither Engaged nor Disengaged* answer was significant. Only 26% (4) of Environmental/Sustainability managers indicated that stakeholders were neither engaged nor disengaged in comparison to 48% (10) and 43% (13) of ICT/IT and Other managers respectively. The similarity in percentages of *Yes* and *No* answers to engagement may be due to ICT/IT and Environmental/Sustainability Managers being closer to stakeholders and being likely to monitor engagement, as it is they who typically run green ICT projects. However, the disparity in percentage responses of stakeholders being “Neither Engaged” nor “Disengaged”, with ICT managers responding at a 48% rate and Environmental or Sustainability managers responding at just a 26% rate, may be due to the fact that ICT/IT managers are only contacted by stakeholders when there is an issue with technology. So long as ICT systems are in working order, stakeholders are not likely to contact them with problems, so are seen to be engaged. This is likely to be why Other managers answered at a similar response rate.
As implementing and participating in green ICT projects often falls under the remit of environmental or sustainability managers, they are closer to stakeholders during that time and are likelier to experience a clear level of engagement or disengagement so this response proved too vague for them.

Appendix XII.78 Culture of Green ICT

A comparison of responses from each of the three types of managers was made regarding a culture of Green ICT at their respective institutions. Each survey respondent was asked to choose from three possible answers, *Yes*, *No*, and *Somewhat*, regarding a possible culture of participating in green ICT projects at their respective institutions. Their responses are summarised in Table XII.78.

Table XII.78 Comparison of Responses from ICT/IT, Environmental/Sustainability Manager and Other Managers regarding Culture of Green ICT projects.

Job Role	Yes	No	Neither Typical or non-Typical
ICT/IT Manager	48% (10)	19% (4)	19% (4)
Environmental/ Sustainability Manager	33% (5)	20% (3)	20%(3)
Other	27% (8)	20% (6)	20% (6)

Analysis of Comparison of Responses on Culture of Green ICT.

The percentage level of responses to the Yes answer from ICT or IT, Environmental or Sustainability and Other managers varied with 48% (10) of ICT managers. This indicated that green ICT was typical of their institutions culture. 33% (5) of Environmental/Sustainability managers and 27% (8) of Other managers answered the same. However, percentage levels of *No* and *Neither Typical" or Non-Typical* responses for all three categories of managers were very close, reaching between 19% and 20%. Overall, this table of results indicates little or no difference between the *No* and *Neither Typical or Non-Typical* responses from each of the three categories of managers. The only disparity in results is from managers who answered *Yes*.

Appendix XII.79 Government Organisations as Drivers.

ICT/IT, Environmental/ Sustainability and Other Managers each responded to the question regarding the six UK government organisations that were identified as possible drivers. Their responses for each organisation as a driver, were compared a summary of their responses are included in the Table XII.79. Only responses from the UK survey could be considered for this comparison.

Table XII.79 Comparison of Government Organisations as Drivers.

HEFCE.	Excellent Driver	Very Good Driver	Good Driver	Neither Good Nor Bad Driver	Poor Driver	Very Poor Driver
ICT/IT Manager	1	0	3	4	1	0
Environmental/ Sustainability Manager	4	0	3	1	1	0
Other	0	0	6	5	1	0
DEFRA.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	1	5	0	1
Environmental/ Sustainability Manager	0	0	2	7	1	0
Other	0	0	2	7	3	0
DECC.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	1	4	1	1
Environmental/ Sustainability Manager	0	0	3	6	1	0
Other	1	0	2	6	3	0

Salix.	Excellent Driver	Very Good Driver	Good Driver	Neither Good Nor Bad Driver	Poor Driver	Very Poor Driver
ICT/IT Manager	2	0	1	4	0	0
Environmental/ Sustainability Manager	2	0	4	3	1	0
Other	0	0	3	6	3	0
Local Authority.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	0	5	1	1
Environmental/ Sustainability Manager	0	0	1	5	3	0
Other	0	0	2	5	3	1
Other Organisations.	**Excellent Driver**	**Very Good Driver**	**Good Driver**	**Neither Good Nor Bad Driver**	**Poor Driver**	**Very Poor Driver**
ICT/IT Manager	0	0	2	6	0	0
Environmental/ Sustainability Manager	1	0	0	7	1	0
Other	0	0	0	7	3	0

Analysis of Comparison of Responses from Managers regarding Government Organisations as Drivers.

While ICT/IT managers and Environmental/Sustainability managers indicated that HEFCE was an excellent driver, Other managers did not. However, all three categories of managers did not agree that HEFCE was a very good driver or a very poor driver, scoring zero from each group. Similarly, just one respondent from all three categories of managers indicated that HEFCE was a poor driver. Overall there was a mixture of results indicating that HEFCE was considered a *Good Driver, Neither a Good Nor Bad Driver* and a *Poor Driver* by all three categories of managers. None of the managers in all three categories of job roles indicated that DEFRA was either an *Excellent Driver or a Very Good Driver.* With the exception of one ICT/IT manager, they each also indicated that DEFRA was a very poor driver.

The remaining descriptions of DEFRA from each of the three categories of job roles included being a *Good Driver, Neither Good Nor Bad Driver and a Poor Driver* in varying amounts. Seven managers in both the Environmental/Sustainability Manager and Other mangers categories indicated that DEFRA was *Neither a Good Nor Bad Driver* and two managers from both categories indicated that it was *Good Driver*. Overall the results indicate that DEFRA was not a particularly strong driver within the sector. All three categories of managers indicated that they did not feel that DECC was neither an excellent driver nor a very good driver nor was it a very poor driver, with the exception of one Other manager who felt that it was an excellent driver and one ICT/IT managers who indicated that it was a very poor driver. The DECC being a *Good Driver, Neither a Good Nor Bad Driver* or being a *Poor Drive*r were confirmed by each of the three categories of managers in mixed amounts with the majority of Environmental/Sustainability and Other managers indicating it was Neither. None of the three categories of managers indicated that Salix was a *Very Good Driver* or a *Very Poor Driver*. However, both ICT or IT Managers and Environmental or Sustainability managers indicated that Salix was an *Excellent Driver*. The remaining responses from all three categories of managers indicated that Salix was considered a *Good Driver, Neither a Good Nor Bad Driver* and *Poor Driver* at varying levels. Overall, the results indicate mixed opinions about Salix. None of the three categories of managers indicated that their Local Authority was an *Excellent Driver or a Very Good Driver*. Each of the categories of managers indicated that Local Authorities were a mixture of *Good Drivers, Neither Good Nor Bad Drivers*, *Poor or Very Poor Drivers*. Coincidentally, five managers from all three

categories of managers indicated that Local Authorities were *Neither Good Nor Bad Driver* and three Environmental or Sustainability and Other managers indicated that Local Authorities were *Poor Drivers*. Overall Local Authorities effectiveness as drivers for green ICT projects was considered to be average. The majority of each the three categories of respondents indicated that Government Funded Research was an neither an *Excellent Driver, a Very Good or a Good Driver*, with the exception of one Environmental/Sustainability manager who indicated that they could be an *Excellent Driver* and two ICT/IT managers who indicated that they could be a *Good Driver*. Other government funded research projects were for the most part considered to be *Neither a Good nor a Bad Driver* as they scored the highest responses from all three categories of managers. Both Environmental and Sustainable and Other managers indicated that Other government funded research were *Poor Drivers* except for ICT managers who did not, with none of the managers indicating they were *Very Poor Drivers*. Overall results indicated that Other Government Funded Research organisations are not strong drivers.

Appendix XII.80 Performance of Green Technology

A comparison of the responses from ICT or IT, Environmental or Sustainability and Other category of manager relating to green ICT delivering on the financial and carbon savings promised by IT companies, was made and a summary of those comparisons are included in Table XII.80.

Table XII.80 Comparison of Responses from ICT/IT, Environmental/Sustainability Manager and Other Managers regarding Performance of Green Technology.

Job Role	Yes	No	Somewhat
ICT/IT Manager	10% (2)	24% (5)	38% (8)
Environmental/ Sustainability Manager	0%	7% (1)	60% (9)
Other	10% (3)	10% (3)	40% (12)

Analysis of Comparison of Responses on Financial and Carbon Savings.

Just 10% (2) of ICT/IT Managers and 10% (3) of Other managers agreed that green technology delivers on the financial and carbon savings promised by IT companies. Surprisingly none of the Environmental/Sustainability Managers indicated the same. 24% (5) of ICT/IT Managers, 7% (1) of Environmental/Sustainability Managers and 10% (3) of Other managers indicated that green technology did not deliver on financial and carbon savings. 38%(8), 60%(9) and 40%(12) of ICT, Environmental and Other managers respectively, indicated that the green technology somewhat delivered on cost and carbon savings. Overall there was a mixture of results with one exception, a 0% response rate from environmental managers indicating they did not believe green ICT's ability to deliver on promised savings.

Appendix XII.81 Cuts in Funding

A comparison of responses from ICT/IT, Environmental/Sustainability and Other managers to the question pertaining to Cuts in Funding to the educational sector and how they affected their institutions' ability to participate in sustainable ICT projects, was made. A summary of those responses is compared in Table XII.81

Table XII.81 Comparison of Responses from ICT/IT, Environmental/Sustainability Manager and Other Managers regarding Effects of Cut in Funding.

Job Role	Yes	No	Somewhat
ICT/IT Manager	43% (9)	33% (7)	0%
Environmental/Sustainability Manager	0%	33% (5)	33% (5)
Other	17% (5)	23% (7)	20% (6)

Analysis of Comparison of Responses to Cuts in Funding.

43% (9) of ICT/IT Managers and 17% (5) of Other mangers indicated that their institution had been affected by cuts in funding to the sector. Surprisingly, none of the Environmental or Sustainability managers stated that they had been affected. However, 33% of both ICT or IT and Environmental or Sustainability Managers said that they had not been affected as did 23%(7) of other managers. None of the ICT/IT

Managers indicated that they had been somewhat affected but 33% (5) of Environmental or Sustainability Managers and 20% (6) of Other managers indicated their institutions had been somewhat affected. The zero percentage response rate from Environmental or Sustainable managers on questions relating to cuts in funding and green technology delivering on cost and carbons savings indicated that examining the financial aspects of environmental projects, may not always fall under the remit of many Environmental/ Sustainable, ICT or IT managers, but instead is managed by Procurement and Finance managers and those working in administration.

To establish any disparity in responses from managers regarding how membership of a purchasing framework might affect their institutions' ability to implement greener ICT initiatives, responses from each of the three job roles were compared. Survey respondents were invited to choose more than one answer option and results are summarised in Table XII.82.

Appendix XII.82

To establish any disparity in responses from managers regarding how budget-holders and decision-makers and/or membership of a purchasing framework might affect their institutions' ability to implement greener ICT initiatives, responses from each of the three job roles were compared and tables in Appendix XII.82 below.

Table XII.82 Comparison of Responses from ICT or IT, Environmental or Sustainability Manager and Other Managers to Membership of Purchasing Frameworks.

Responses	ICT/IT manager	Environmental/Sustainable Manager	Other
Yes, we are part of a framework and I feel supported in my decisions to purchase green ICT.	3 (33%)	5 (55.55%)	5 (35.71%)

Yes, we are part of a framework but I do not feel supported in my decisions to purchase green ICT.	1 (11%)	3(33%)	4 (28.57%)
No, we are not part of a framework but I still feel supported in my decisions to purchase green ICT.	1 (11%)	0	1 (7.14%)
No, we are not part of a framework and I do not feel supported in my decisions to purchase green ICT.	0	0	0
Not sure if we are part of a framework, but I feel supported in my decisions to purchase green ICT.	3 (33%)	0	1(7.14%)
Not sure if we are part of a framework, but I do not feel supported in my decisions to purchase green ICT.	1 (11%)	1 (11%)	3(21.42%)
Total Number of ICT/ IT Managers who replied.	9 (100%)	9 (100%)	14 (100%)

Analysis of Comparison of Responses to Purchasing Frameworks.

Results are mixed with 33% (3) of ICT /IT managers, 55% (5) of Environmental/Sustainable Managers and 35.71% (5) of Other managers indicating their institutions were part of a framework and they felt supported in their decisions to purchase green ICT. 11% (1) of ICT/IT managers 33% (3) of Environmental/Sustainable Managers and 28.57% (4) of Other managers indicated that while they were part of a framework they did not feel supported in their decisions to purchase green ICT. 11% (1) of ICT/IT managers none of the Environmental/Sustainable Managers and 7.14% (1). Environmental/Sustainable

Manager indicated that they were not part of a framework but still felt supported in their decisions to purchase green ICT. None of the managers from either of the three categories of job roles indicated they were not part of a framework and did not feel supported in their decision to purchase green ICT. 33% (3) of ICT or IT managers none of the Environmental or Sustainable Mangers and 7.14% (1) of Other managers indicated not being sure if they were part of a framework, but still felt supported in their decisions to purchase green ICT. 11%(1) of ICT or IT managers and of Environmental or Sustainable Managers (1) and 21.42% (3) of Other managers indicated they were not sure if they were part of a framework, but did not feel supported in their decisions to purchase green ICT. Results indicated a general mix of responses from each of the categories of managers with the majority of managers from all three categories of roles, being aware of their institution belonging to a framework of sorts, but not necessarily feeling supported in their decision to purchase Green ICT. Similar to the outcomes of previous comparisons, results indicate a mixture of responses indicating both the presence and absence of frameworks being a barrier.

Appendix XII.83 Lacking Managers.

To establish any disparity in responses from managers regarding how ICT/IT managers in their institutions might be lacking, responses from surveys from each of the three job roles were compared. Survey respondents were invited to choose more than one option as ICT managers are frequently lacking in more than one resource. Results are summarised in Table XII.83.

Table XII.83 Lacking Characteristics of ICT Managers.

Lacking Characteristics	ICT/IT manager	Environmental/Sustainable Manager 15	Other 30	Total Number of Respondents for each lacking Characteristic
Poor knowledge of green ICT issues	3 (37.5%)	2 (25%)	3 (37.55%)	8
Disinterest in green ICT initiatives.	2 (14.28%)	3 (21.42%)	9 (64.28%)	14
Disinterest in “outside” green ICT initiatives.	2 (25%)	2 (25%)	4 (50%)	8
Is negatively influenced by institutional politics.	1 (7.69%)	3 (23.07%)	9 (69.21%)	13
Is under-resourced in terms of funding for new technology.	4 (25%)	5 (31.25%)	7(43.75%)	16
Is under resourced in terms of allocation of support staff.	5 (33.33%)	6 (40%)	4(26.66%)	15

Is under resourced in terms of allowances for staff training, upskilling, etc.	4 (28.57%)	4 (28.57%)	6 (42.85%)	14
None of the above.	7 (50%)	2 (14.28%)	5 (35.71%)	14

Analysis of Comparison of Responses on Lacking ICT managers.

Overall the results are quite similar with each of the categories of managers identifying with each of the lacking characteristics in their institution's ICT managers. The largest lacking characteristic recognised was being negatively influenced by institutional politics with the majority of Other managers answering this way too. In contrast, this was also the least commonly occurring lacking characteristic as far as ICT/IT managers were concerned. Other managers indicated that their institutions' ICT managers were negatively influenced by institutional politics yet only one ICT/IT manager indicated this characteristic. However, when each of the lacking characteristics are totalled, being under-resourced, in terms of funding for new technology, is the most common barrier to participation in sustainable ICT projects resonating with a total of sixteen managers. Other commonly found barriers include being under-resourced in terms of allocation of support staff, allowances for staff training and having a disinterest in outside green ICT amongst others. In contrast, fourteen respondents indicated that their ICT managers were not lacking in any of the characteristics mentioned.

It is also important at this stage of the data analysis, to point out that there are discrepancies in both datasets. 31/60 or (51.6%) of UK surveys and 6/15 (39%) of Irish survey were left incomplete. Their levels of incompletion varied with some of the surveys having only one or two question left unanswered. For others, the surveys contained as little as five answered questions. The researcher decided to take all data, regardless of whether they came from a complete or incomplete questionnaire, and factor them into the overall outcome of the survey. The researcher decided that responses from incomplete surveys were still valid and therefore still contributed to the overall outcomes of their respective surveys and the overall outcome of the

research. In addition, one of the UK survey respondents was from an Irish institution. However, the same respondent also took the Irish survey when it was circulated to managers as part of the Irish ICT Managers mailing list. In this instance the researcher considered both responses as valid as they were deemed valid at the time of completion of the survey. Despite these minor discrepancies in data, none of them affected the identification of any of the several barriers to participation in sustainable ICT projects. There were ample data from all forms of responses valid responses that subsequently answered the research questions. However, because of the discrepancies in some of the questionnaires' responses, the researcher decided to carry out a series of follow on semi-structured interviews to further investigate the present or absence of barriers. Responses to semi-structured interviews would offer qualitative data to the research and also add validity and robustness to both datasets, thereby offering complete triangulation of the data used in this reserach.
In fact, as many of the surveys were incomplete this was another indication of poor stakeholder engagement and lacking managers.

Appendix XII.84 Semi-Structured Interviews.

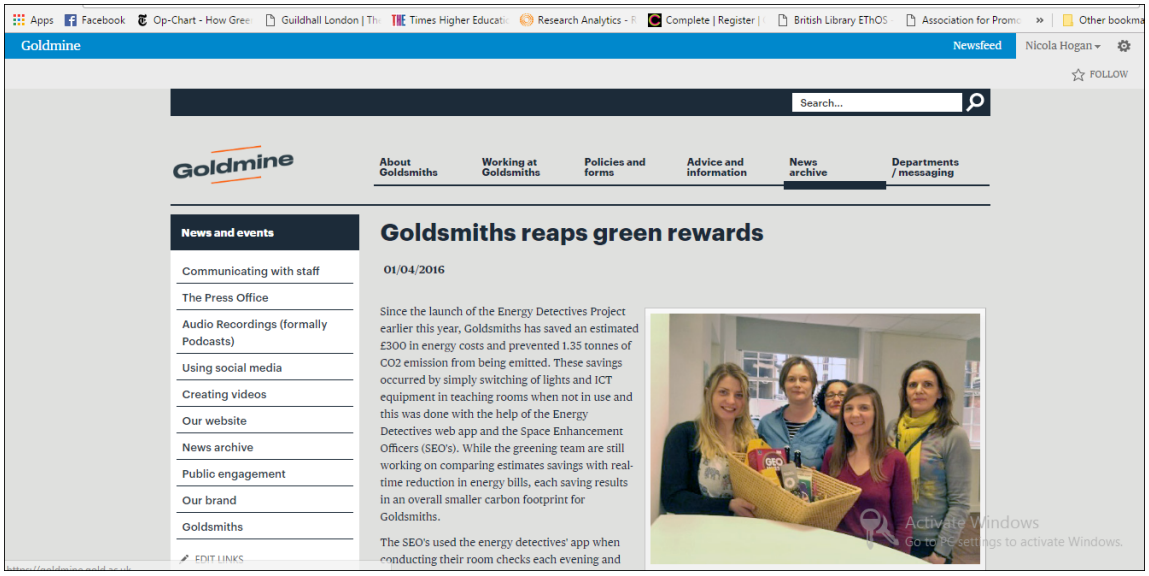
To ensure a robust and reliable dataset that demonstrated triangulation with previous datasets, a series of follow up semi-structured interviews were conducted to validate the larger dataset. In total, fifteen people were interviewed as a follow up to the responses of the larger survey. These semi-structured interviews were designed with reiteration and validation of responses to the larger survey in mind. Participants were reminded of their response to their original survey and asked if they would still give the same responses.
The fifteen interviewees included 7 ICT/IT managers and 8 environmental/sustainability managers.

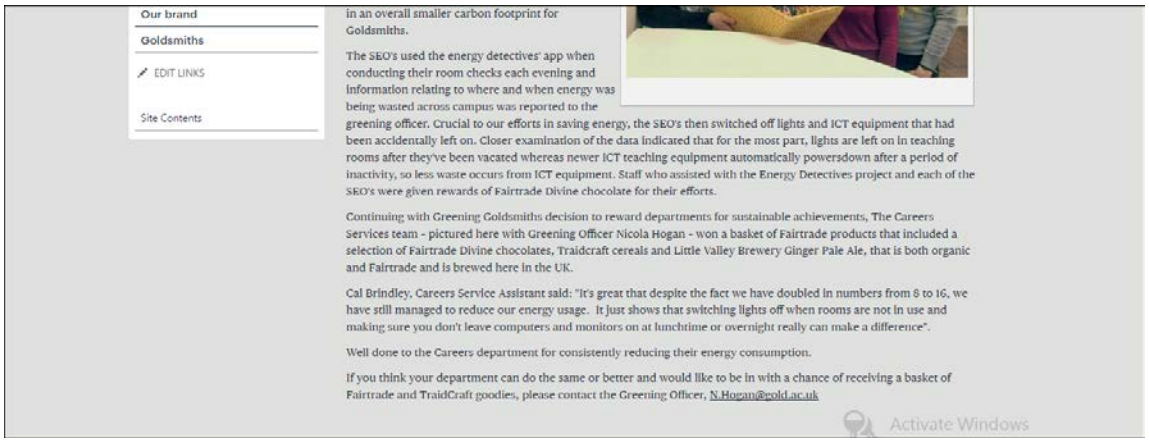
Appendix XII.85 Summary of Data Analysis and Results.

This chapter has reported the results of both the UK and Irish surveys that aimed at identifying barriers to participation in ICT projects in universities and colleges. It includes an analysis of each of the responses of both surveys as well as each of the three different cross-analyses of both surveys. Results of both surveys confirm the presence of each of the seven barriers and highlights considerable overlap in many of the responses. It also highlights the disparity in many of the results, where, not only did barriers *not* exist, they aided institutions in implementing the

use of more sustainable technology. In fact, when conducting the semi structured interviews, the researcher received the same responses to the questions as before and from both categories of managers .i.e. the data had reached saturation point. Finally, the datasets in section (i) and (ii) of this chapter are reliable, valid and are triangulated. They are reliable and are reproducible owing to the fact that if the same survey were carried out at a future date, the researcher is confident that the same results would be produced. This data are also valid as each of the questions asked were worded correctly, in a direct manner and pertained to each of the possible barriers and ultimately answered each of the research questions. Finally, the questions were circulated to various managers within the FHE sector and are therefore valid. The data is also further triangulated as the results of the UK and Irish survey are similar and therefore support each other. The same too can be said of the results of the preliminary surveys carried out as part of the UK SUSTE-TECH project. A conclusion of each of the barriers is included in Chapter 7.

Appendix XIII. Article in staff news showing The Careers Department having reduced their overall energy use in 2015-2016.





Appendix XIV: Front Page of the Leopard Newspaper.

Deferred graduation dates

Goldsmiths moves graduation dates to July p3

Goldsmiths open cinema with Curzon

First cinema comes to Lewisham after 15 years p4

Goldsmiths' student discusses cuts to DSA

How government cuts are affecting disabled students p7

Has the SU improved sports?

The Leopard Sports Editor investigates p24

The LEOPARD

Official Goldsmiths student newspaper

Greening Goldsmiths creates web app to report energy waste on campus

...University has made great ...saving energy across ...us over the past 2 years.

...e Estates and Facilities ...at the University has saved an ...£50,000 on their energy bill and ...CO2 emissions by 10%.

...have mainly been due to the

...ect is the replacement ...heating systems with ...and repairing of existing

Prior to this, heat was not being generated as efficiently as it should have and when it was generated, it was escaping from offices and classrooms due to poor insulation. However, despite these changes energy is still being wasted across campus.

Lights, ICT equipment and other electronic equipment are not being switched off after use in seminar rooms, lecture theatres and studios.

It was at this point Greening Goldsmiths, a sub-department within Estate and Facilities, created the Energy Detectives web app.

The Energy Detectives is essentially a webpage that allows staff and students to report where and when they see energy being wasted across Goldsmiths campus. The Energy Detectives webpage can be accessed via the Internet by typing edetect.gold.ac.uk into the Goldsmiths' homepage browser.

Users of the web app need to be both using any model smart phone and be connected to Eduroam, a Wi-Fi connection exclusive to universities.

Once logged into the Energy Detectives webpage a drop down menu with the list

...of buildings on campus and the typ... ...wastage occurring will appear, the ... ...should then make the choices acc...

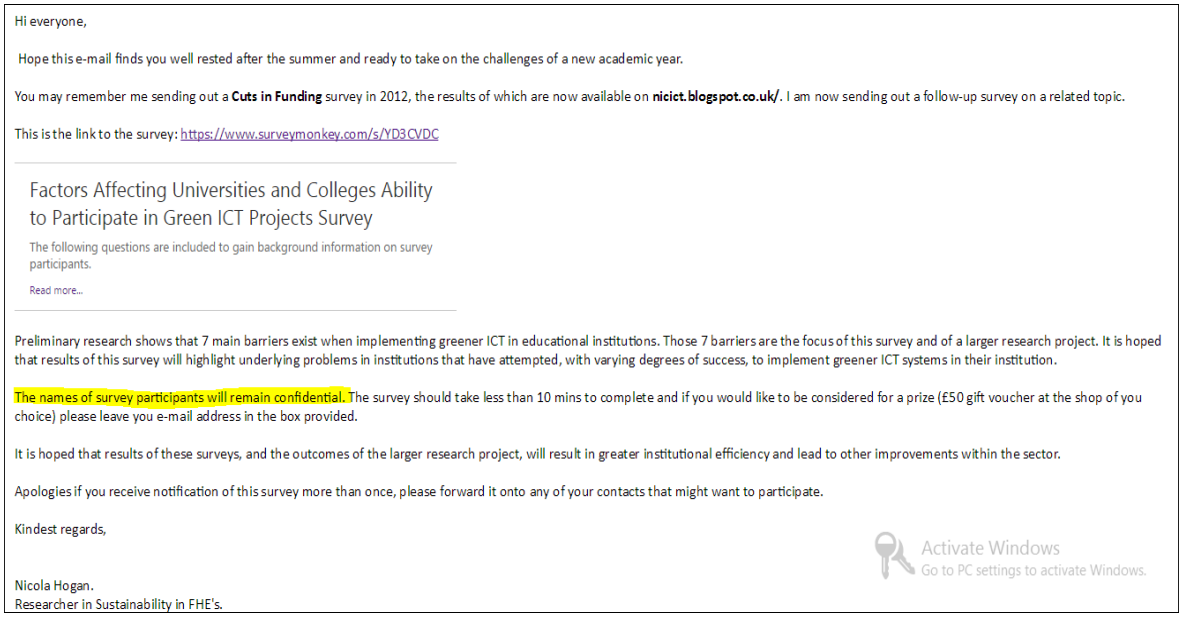
Users can also take a picture of ... ...where energy is being wasted as ... ...evidence.

Margaret Jennings, a second y... ...student at Goldsmiths, said th... ...Detectives was an "easy and ... ...document energy usage" wh... ...out on campus.

Peter Yxell, an MA student ...

(continued on page 2)

Appendix XV: E-mail to potential survey participants stating that the names of participants of the surveys would remain confidential.



Hi everyone,

Hope this e-mail finds you well rested after the summer and ready to take on the challenges of a new academic year.

You may remember me sending out a **Cuts in Funding** survey in 2012, the results of which are now available on **nicict.blogspot.co.uk/**. I am now sending out a follow-up survey on a related topic.

This is the link to the survey: https://www.surveymonkey.com/s/YD3CVDC

Factors Affecting Universities and Colleges Ability to Participate in Green ICT Projects Survey

The following questions are included to gain background information on survey participants.

Read more...

Preliminary research shows that 7 main barriers exist when implementing greener ICT in educational institutions. Those 7 barriers are the focus of this survey and of a larger research project. It is hoped that results of this survey will highlight underlying problems in institutions that have attempted, with varying degrees of success, to implement greener ICT systems in their institution.

The names of survey participants will remain confidential. The survey should take less than 10 mins to complete and if you would like to be considered for a prize (£50 gift voucher at the shop of you choice) please leave you e-mail address in the box provided.

It is hoped that results of these surveys, and the outcomes of the larger research project, will result in greater institutional efficiency and lead to other improvements within the sector.

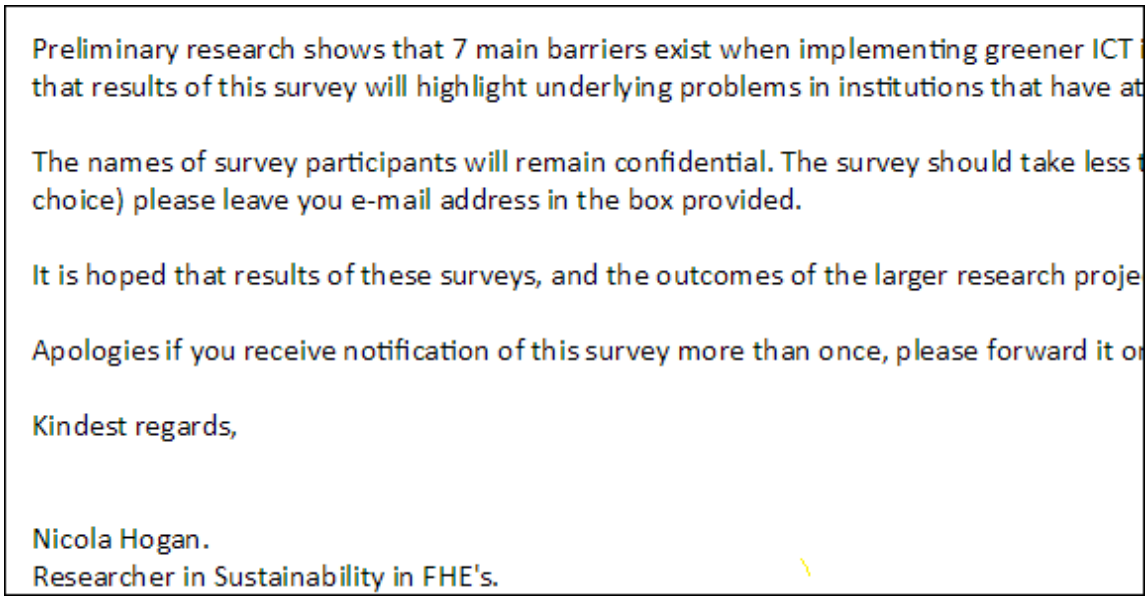
Apologies if you receive notification of this survey more than once, please forward it onto any of your contacts that might want to participate.

Kindest regards,

Activate Windows
Go to PC settings to activate Windows.

Nicola Hogan.
Researcher in Sustainability in FHE's.

Closer view of above email.



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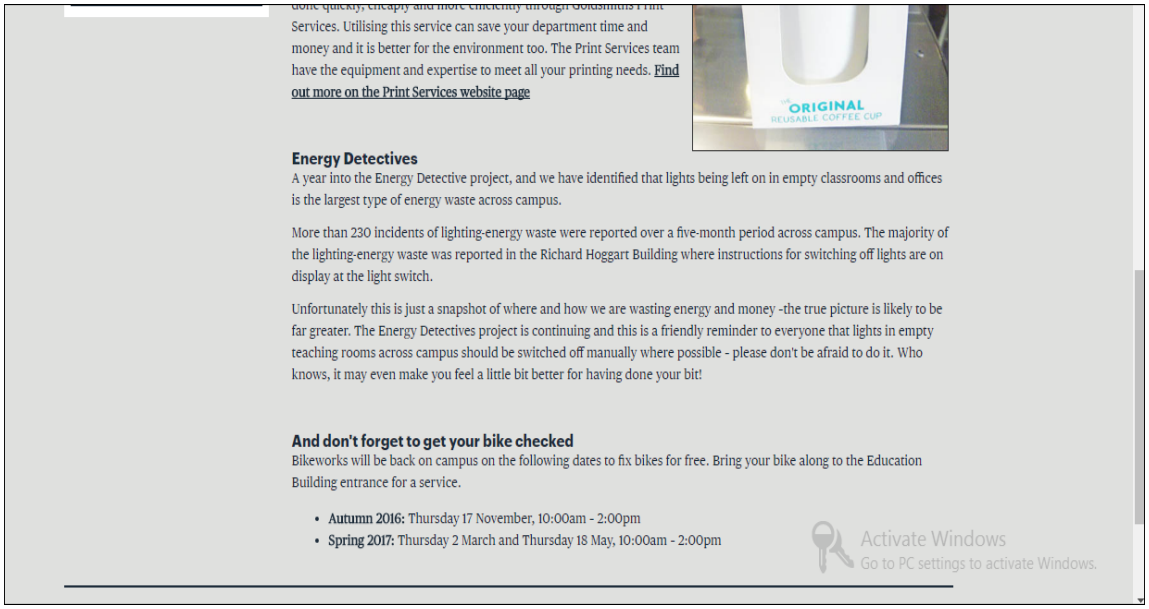
Apologies if you receive notification of this survey more than once, please forward it or

Kindest regards,

Nicola Hogan.
Researcher in Sustainability in FHE's.

Appendix XVI.1: Articles explaining how the Energy Detectives project worked, the institutional and individual benefits of using it and how staff could get involved.



done quickly, cheaply and more efficiently through Goldsmiths Print Services. Utilising this service can save your department time and money and it is better for the environment too. The Print Services team have the equipment and expertise to meet all your printing needs. Find out more on the Print Services website page

Energy Detectives

A year into the Energy Detective project, and we have identified that lights being left on in empty classrooms and offices is the largest type of energy waste across campus.

More than 230 incidents of lighting-energy waste were reported over a five-month period across campus. The majority of the lighting-energy waste was reported in the Richard Hoggart Building where instructions for switching off lights are on display at the light switch.

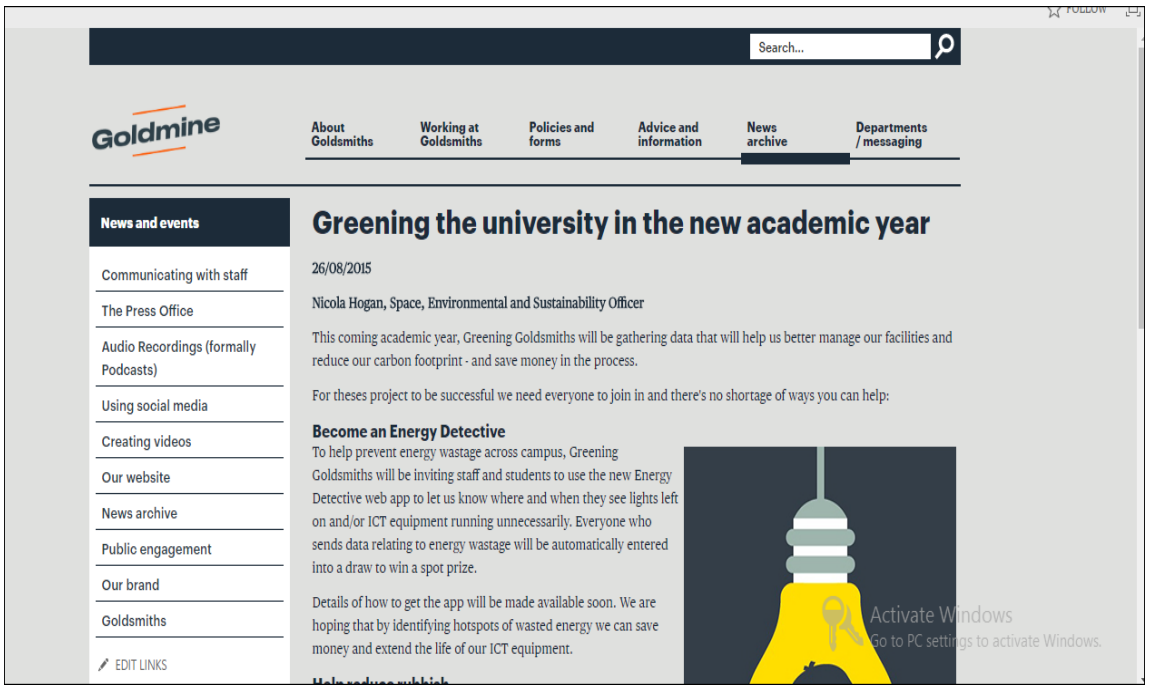
Unfortunately this is just a snapshot of where and how we are wasting energy and money -the true picture is likely to be far greater. The Energy Detectives project is continuing and this is a friendly reminder to everyone that lights in empty teaching rooms across campus should be switched off manually where possible - please don't be afraid to do it. Who knows, it may even make you feel a little bit better for having done your bit!

And don't forget to get your bike checked

Bikeworks will be back on campus on the following dates to fix bikes for free. Bring your bike along to the Education Building entrance for a service.

- **Autumn 2016:** Thursday 17 November, 10:00am - 2:00pm
- **Spring 2017:** Thursday 2 March and Thursday 18 May, 10:00am - 2:00pm

Appendix XVI.2



Greening the university in the new academic year

26/08/2015

Nicola Hogan, Space, Environmental and Sustainability Officer

This coming academic year, Greening Goldsmiths will be gathering data that will help us better manage our facilities and reduce our carbon footprint - and save money in the process.

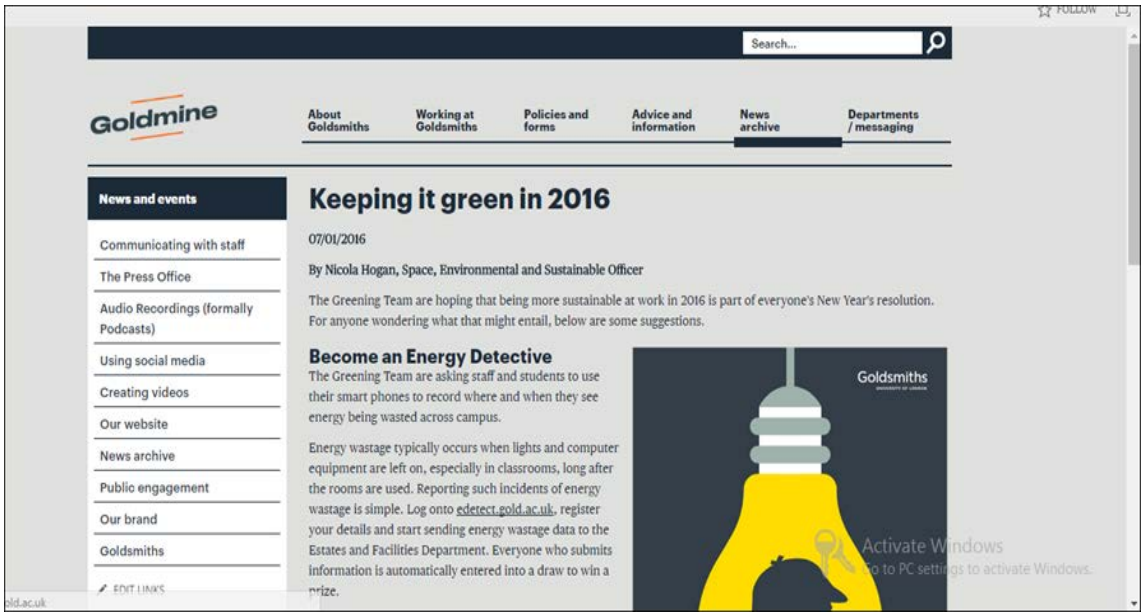
For theses project to be successful we need everyone to join in and there's no shortage of ways you can help:

Become an Energy Detective

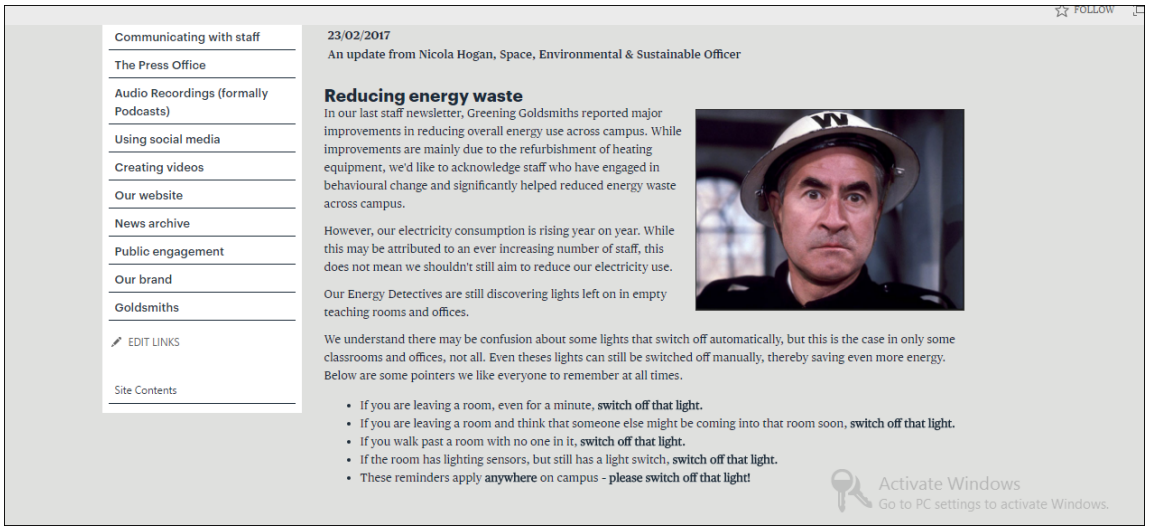
To help prevent energy wastage across campus, Greening Goldsmiths will be inviting staff and students to use the new Energy Detective web app to let us know where and when they see lights left on and/or ICT equipment running unnecessarily. Everyone who sends data relating to energy wastage will be automatically entered into a draw to win a spot prize.

Details of how to get the app will be made available soon. We are hoping that by identifying hotspots of wasted energy we can save money and extend the life of our ICT equipment.

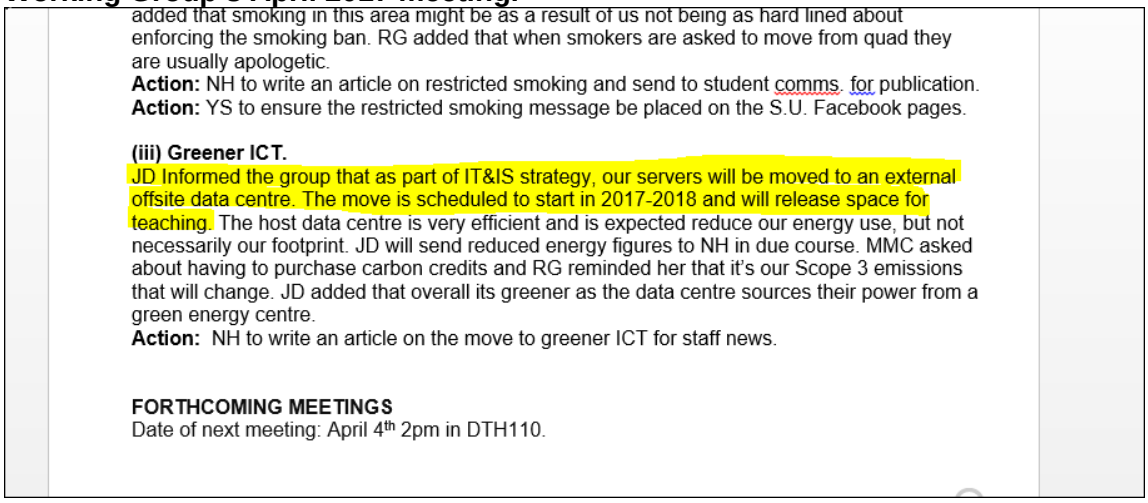
Appendix XVI.3



Appendix XVI.4



Appendix XVII: Minutes of the Goldsmiths Environmental and Sustainable Working Group's April 2017 meeting.



added that smoking in this area might be as a result of us not being as hard lined about enforcing the smoking ban. RG added that when smokers are asked to move from quad they are usually apologetic.
Action: NH to write an article on restricted smoking and send to student comms. for publication.
Action: YS to ensure the restricted smoking message be placed on the S.U. Facebook pages.

(iii) Greener ICT.
JD Informed the group that as part of IT&IS strategy, our servers will be moved to an external offsite data centre. The move is scheduled to start in 2017-2018 and will release space for teaching. The host data centre is very efficient and is expected reduce our energy use, but not necessarily our footprint. JD will send reduced energy figures to NH in due course. MMC asked about having to purchase carbon credits and RG reminded her that it's our Scope 3 emissions that will change. JD added that overall its greener as the data centre sources their power from a green energy centre.
Action: NH to write an article on the move to greener ICT for staff news.

FORTHCOMING MEETINGS
Date of next meeting: April 4th 2pm in DTH110.